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LIST OF ACRONYMS

AGI	Amplified Geochemical Imaging
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
AST	Aboveground Storage Tank
BERA	Baseline Ecological Risk Assessment
BGS	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
BRAWP	Baseline Risk Assessment Work Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFAC	Columbia Falls Aluminum Company, LLC
COC	Chain of Custody
COPC	Contaminants of Potential Concern
CPP	Citizens Participation Plan
CSM	Conceptual Site Model
CWA	Clean Water Act
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DU	Decision Unit
ECOS	U.S. Fish and Wildlife Service Environmental Conservation Online System
E&E	Ecology and Environment, Inc.
ERA	Ecological Risk Assessment
EDR	Environmental Data Resources
FRTR	Federal Remediation Technology Roundtable
FS	Feasibility Study
FT-AMSL	Feet Above Mean Sea Level
FT-BLS	Feet Below Land Surface
FWP	Fish, Wildlife and Parks
GIS	Geographic Information Systems
gpm	Gallons Per Minute
HASP	Health and Safety Plan
ITRC	Interstate Technology & Regulatory Council
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Code Annotated
MCL	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goals
MGD	Million Gallons Per Day
MGWPCS	Montana Ground Water Pollution Control System
MNHP	Montana National Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
MSW	Municipal Solid Waste

LIST OF ACRONYMS

MSWLF	Municipal Solid Waste Landfills
MDEQ	Montana Department of Environmental Quality
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
ORP	Oxygen Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
PAH	Polyaromatic Hydrocarbon Compounds
PCB	Polychlorinated Biphenyls
PCDDs	Polychlorinated dibenzo-p-dioxins
PCDFs	Polychlorinated dibenzofurans
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSL	Regional Screening Levels
SAP	Sampling and Analysis Plan
SCDM	Superfund Chemical Data Matrix
SDWA	Safe Drinking Water Act
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific Management Decision Point
SOP	Standard Operating Procedure
SPL	Spent Potliner
SWPPP	Stormwater Pollution Prevention Plan
SVOC	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TBC	To-Be-Considered
TCLP	Toxicity Characteristic Leaching Procedure
UCL	Upper Confidence Limit
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WET	Whole Effluent Toxicity
WQS	Water Quality Standards

EXECUTIVE SUMMARY

On behalf of Columbia Falls Aluminum Company, LLC (CFAC), Roux Associates, Inc., has prepared this Remedial Investigation/Feasibility Study (RI/FS) Work Plan (hereinafter the "RI/FS Work Plan") for the CFAC aluminum reduction facility located near Columbia Falls, Flathead County, Montana (hereinafter, "the Site"). The boundaries of the Site as defined in the RI/FS Work Plan are depicted in Plate ES-1. The Site was operated as a primary aluminum reduction facility (commonly referred to as an aluminum smelter) from 1955 until 2009. Aluminum production at the Site was suspended in 2009 due to a downturn in aluminum market conditions, and CFAC announced the permanent closure of the facility in March 2015. Since that time, CFAC has initiated decommissioning and demolition activities and has commissioned the development of an RI/FS Work Plan. The purpose of an RI/FS is to characterize the nature and extent of risks associated with environmental conditions at the Site and to evaluate potential remedial options to address those risks. More specifically, the RI/FS is designed to achieve the following objectives:

1. Identify contaminants of potential concern (COPCs) at the Site and their source(s);
2. Determine the nature and extent of Site-related COPCs in environmental media (soil, groundwater, surface water and sediment) at the Site;
3. Understand the fate and transport of COPCs in environmental media at the Site;
4. Identify any exposure pathways (considering both current and potential future land use);
5. Evaluate current and potential future human health and ecological risks posed by the COPCs present at the Site; and
6. Conduct an evaluation of remedial alternatives for the Site, including treatability studies where necessary.

This RI/FS Work Plan provides an overview of pertinent background information, an initial evaluation of existing data for the Site (including a preliminary Conceptual Site Model [CSM]), the identification of data needs to support the risk assessment and evaluation of remedial alternatives, and a scope of work designed to address the identified data needs. The RI/FS Work Plan also provides the framework and approach for conducting a baseline risk assessment and feasibility study.

The RI/FS Work Plan methodology is in accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988) as well as other appropriate EPA and Montana Department of Environmental Quality (MDEQ) guidance; and, compliant with the substantive requirements of the National Contingency Plan ("hereinafter "NCP") (40 CFR 300).

The RI/FS will be conducted in a phased approach to achieve the objectives outlined above. The Phase 1 Site Characterization will begin with detailed Site reconnaissance, followed by use of surface geophysics and soil gas screening methods, in an effort to optimize the placement of sampling locations. Then a sampling program will be implemented to provide detailed characterization of known and potential source areas, as well as broad characterization of hydrogeology, soil, groundwater, surface water and sediment across the Site. The Phase 1 Site Characterization will also include a wildlife habitat and biological survey to support performance of a Screening Level Ecological Risk Assessment (SLERA) in accordance with USEPA guidance.

The proposed Phase 1 Site Characterization sampling locations are depicted on Plate ES-1. As designed, the Phase 1 Site Characterization sampling program includes:

- Drilling of approximately 139 soil borings with associated soil sampling and analysis at each boring location;
- Systematic collection and analysis of an additional 43 surface and 43 shallow soil samples on a gridded basis across a large portion of the Site;
- Installation of approximately 43 monitoring wells, with subsequent collection and analysis of groundwater samples from all newly installed and existing monitoring wells; and
- Collection and analysis of surface water and sediment samples from approximately 9 locations within the Flathead River, 3 locations in Cedar Creek, and 4 locations in the Cedar Creek Overflow Drainage.

The results of the above activities will be evaluated and presented in a Phase I Site Characterization Summary Report. This will include: presentation and discussion of all Phase 1 Site Characterization results, an update of the CSM, identification of the data needs that remain outstanding to achieve the RI objectives; and a Phase II Site Characterization sampling and analysis plan designed to address the data needs.

The RI/FS Work Plan specifies that the potential for defining operable units or using interim actions to accelerate remedial progress and risk reduction will be considered during the course of the Phase 1 Site Characterization Program and at its completion. As such opportunities are identified they will be evaluated. If a viable interim action appears to exist that meets applicable NCP criteria, a plan for such action will be prepared.

A Baseline Risk Assessment Work Plan will be prepared based upon the results of the Phase 1 Site Characterization. Following implementation of the Phase II Site Characterization and any additional phases of investigation deemed necessary, a Baseline Risk Assessment Report will be prepared to document the risk assessment process, methodology, and results. The results of all Site investigations will be presented collectively in a RI Summary Report.

A feasibility study (FS) will be conducted to evaluate remedial options to address any identified human health and environmental risks. The first phase of the FS, to commence following the Phase 1 Site Characterization, will identify and screen remedial and Site management technologies and methods based upon effectiveness, implementability, and cost. The screening process will utilize applicable USEPA and MDEQ guidance to identify candidate technologies and process options for assembly into remedial alternatives. The results of the technology screening process will be summarized in a technical memorandum.

A FS Work Plan will be prepared following completion of the RI Summary Report. The FS Work Plan will establish remedial action objectives (considering both USEPA and MDEQ standards and risk assessment results), identify areas and volumes of contamination exceeding the identified Remedial Action Objectives (RAOs) and identify remedial alternatives retained for detailed evaluation.

A FS Report will be prepared following the detailed evaluation of remedial alternatives. The FS Report will be prepared to document the entire FS process and serve as the basis for remedy selection at the Site. The detailed evaluation of alternatives shall apply the first seven of the nine evaluation criteria described in the NCP, to the assembled remedial alternatives. The nine evaluation criteria include: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state (or support agency) acceptance; and (9) community acceptance. Criteria 8 and 9 are anticipated to be addressed by the appropriate regulatory authority after the FS Report and the Proposed Plan have been released to the general public for comment.

All of the RI/FS tasks will be conducted under the oversight of the USEPA. All deliverables listed above, as well as any additional deliverables required during the course of the project, will be initially submitted to USEPA and MDEQ as draft documents. Following receipt of USEPA comments, the documents will be revised as appropriate and submitted in final form for approval by USEPA.

The major phases of work and deliverables outlined in this Draft RI/FS Work Plan along with a preliminary schedule of completion dates are listed below:

- ~~RI/FS Work Plan Finalization (4th Quarter 2015);~~
- Phase I Site Characterization Field Program (4th Quarter 2016);
- Phase I Data Summary Report ~~and Phase II SAP~~ (1st Quarter 2017);
- Baseline Risk Assessment Work Plan (~~2nd~~-4th Quarter 2017);
- Phase II Site Characterization Field Program (~~4th~~-3rd Quarter ~~2017~~2018);
- Phase II Data Summary Report (1st Quarter 2019);
- Baseline Risk Assessment (3rd Quarter 2019);
- Final RI Report (~~3rd~~-1st Quarter ~~2018~~2020);
- FS Work Plan (~~1st~~-3rd Quarter ~~2019~~2020); and
- Feasibility Study (~~4th~~-1st Quarter ~~2019~~2021).

CFAC is prepared to complete the RI/FS according to the preliminary schedule outlined above and in accordance with the RI/FS Work Plan. However, several factors not within CFAC's control could influence CFAC's ability to complete the RI/FS according to the project schedule, including but not limited to: the regulatory review and approval process, the availability of specialized subcontractors for certain aspects of the work, and the need to modify the scope of work based upon the investigation findings. If a schedule extension is required to meet the due dates for any of the major deliverables, a formal notification and request for a schedule extension will be submitted to USEPA no less than 30 days prior to the deliverable due date. CFAC reserves the right to make changes to the RI/FS Work Plan consistent with the NCP and other applicable rules or orders, including but not limited to the scope of work, schedule and process and retains all rights that it may have under applicable law and contracts.

1.0 INTRODUCTION

On behalf of Columbia Falls Aluminum Company, LLC (CFAC), Roux Associates, Inc. (Roux), has prepared this Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the CFAC aluminum reduction facility located near Columbia Falls, Flathead County, Montana (hereinafter, "the Site"). The boundaries of the Site as defined in the RI/FS Work Plan are depicted in Figure 1. The Site was operated as a primary aluminum reduction facility (commonly referred to as an aluminum smelter) from 1955 until 2009. Aluminum production at the Site was suspended in 2009 due to a downturn in aluminum market conditions, and CFAC announced the permanent closure of the facility in March 2015. Since that time, CFAC has initiated decommissioning and demolition activities and has commissioned the performance of an RI/FS. The purpose of the RI/FS is to characterize the nature and extent of risks associated with environmental conditions at the Site and to evaluate potential remedial options to address those risks. More specifically, the RI/FS is designed to achieve the following objectives:

1. Identify contaminants of potential concern (COPCs) at the Site and their source(s);
2. Determine the nature and extent of Site-related COPCs in environmental media (soil, groundwater, surface water and sediment) at the Site;
3. Understand the fate and transport of COPCs in environmental media at the Site;
4. Identify any exposure pathways (considering both current and potential future land use);
5. Evaluate current and potential future human health and ecological risks posed by the COPCs present at the Site; and
6. Conduct an evaluation of remedial alternatives for the Site, including treatability studies where necessary.

The RI/FS Work Plan has been prepared in general accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988) as well as other appropriate USEPA and Montana Department of Environmental Quality (MDEQ) guidance; and, the substantive RI/FS requirements of the National Contingency Plan (40 CFR 300).

The RI/FS Work Plan provides an overview of pertinent background information (including the Site layout and physical setting, ownership and operational history, and the scope and results of previous environmental investigations and cleanup actions), an initial evaluation of existing data for the Site (including a preliminary Conceptual Site Model), the identification of data needs to support the risk assessment and evaluation of remedial alternatives, and a scope of work designed to address the identified data needs. The Work Plan also provides the framework and approach for conducting a baseline risk assessment and feasibility study.

The RI/FS Work Plan also incorporates by reference accompanying project operation plans. A Sampling and Analysis Plan has been prepared and consists of two parts: 1) a Field Sampling Plan (FSP) that provides guidance for all field work by defining the sampling and data collection methods and procedures to be used; and 2) a Quality Assurance Project Plan (QAPP) that describes the policy, organizational structure, activities and quality assurance and quality control procedures that will be followed to achieve project data quality objectives. A project Health and Safety Plan (HASP) under preparation and will be provided under separate cover.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

This section provides pertinent background information, including a description of the Site and its physical setting, the ownership and operational history of the Site, and the scope and results of previous environmental investigations and cleanup actions conducted at the Site.

2.1 Site Location and Description

The facility is located at 2000 Aluminum Drive near Columbia Falls, Flathead County, Montana. The Site is approximately 2 miles northeast from the center of Columbia Falls and the Site is accessed by Aluminum Drive via North Fork Road (County Road 486). According to the 2013 Census (www.census.gov), the total population of Columbia Falls is 4,796.

The total property owned by CFAC is approximately 3,196 acres (Figure 2). However, the historic footprint of operations and a perimeter buffer zone (collectively referred to hereinafter as the "Site"), consists of approximately 1,340 acres bounded by Cedar Creek Reservoir to the north, Teakettle Mountain to the east, Flathead River to the south, and Cedar Creek to the west (Figure 1). The non-industrial areas of the Site have been previously used for recreational purposes such as hunting and fishing. The remainder of the CFAC owned property is located south of Flathead River and was never used for industrial operations.

Buildings and industrial facilities located at the Site currently include offices, warehouses, laboratories, mechanical shops, paste plant, coal tar pitch tanks, pump houses, casting garage, and the potline facility. The Site also includes seven closed landfills, one active landfill, material loading and unloading areas, two closed leachate ponds, and several wastewater percolation ponds. CFAC received authorization under Montana Pollutant Discharge Elimination System (MPDES) Permit No. MT-0030066 "to discharge process wastewater and ground water containing wastewater from its aluminum reduction facility, to ground waters discharging to the Flathead River" in accordance with the provisions of the permit (Page 1 of 1999 Permit in Appendix C). A rectifier yard and switchyard owned by Bonneville Power Administration and a right-of-way for the Burlington Northern Railroad are also within the Site boundaries.

The nearest residences are located adjacent to the southwest Site boundary, approximately 0.80 miles west of historic footprint of Site operations, in a neighborhood referred to as Aluminum

City. The nearest groundwater wells used for drinking water are located within the Aluminum City neighborhood.

Several production wells historically pumped groundwater that was used both industrial operations and for potable water. However, electric power to these wells has been terminated. Therefore, existing onsite wells are non-operational and they are not currently used for potable water.

A Site Plan depicting relevant Site features is included as Figure 3.

2.2 Site Topography

Plate 1 presents a topographic map of the Site that was prepared based upon a detailed photogrammetric survey completed in 1997. The land surface elevation at the Site varies from approximately 3,000 to 3,250 feet above mean sea level (ft-amsl). On a Site-wide scale, the general slope is in the south-south west direction towards the Flathead River.

Where it borders the Site, the Flathead River is present at an elevation of approximately 3,000 ft-amsl. Adjacent to the Flathead River is an area of land that contains the South Percolation Ponds, where the land surface in this area generally ranges between 3,010 and 3,020 ft-amsl. Immediately to the north of this area is a narrow steep slope that rises to an elevation of approximately 3,100 ft-amsl.

North of the steep slope is the Main Plant Area, where the topography is generally flat with an increase in elevation of approximately 10 feet from west to east across the plant. The area immediately east of the Main Plant increases at a slope of approximately 4° and reaches elevations above 3,200 ft-amsl. East of the Main Plant, the elevation fluctuates by approximately 50 feet locally around Site landfill features and the Cedar Creek overflow drainage as you continue east towards Teakettle Mountain. The Site is bordered by Teakettle Mountain to the east which reaches elevations greater than 5,000 ft-amsl.

In the area north and north-east of the Main Plant, the Site elevations vary locally around Site land fill features and the local slopes can vary significantly. In general, the north-eastern area of the Site is located at elevations greater than 3,200 ft-amsl and slopes south-west towards the Main Plant Area. The East Landfill, located on the north-eastern border of the Site, reaches elevations of 3,250 ft-amsl and is the highest elevated local feature on the Site.

2.3 Climatology

There are two meteorological data stations in the vicinity of the Site which are maintained by the NOAA National Climatic Data Center: Station #248902 located approximately 10 miles west of the Site in Whitefish, Montana and Station #244560 located approximately 6.5 miles southwest of the Site in Glacier Park International Airport. Climate data were downloaded from each station for the time period between 1981 through 2010. The table below summarizes the average annual temperatures and precipitation observed at both stations.

Summary of Climate Data

	Whitefish, MT (Station #248902)	Glacier International Airport (Station #244560)
Average Daily Temperature (°F)	42.4	43.3
Average Daily Max Temperature (°F)	53.5	55.2
Average Daily Min Temperature (°F)	31.2	31.3
Average Annual Precipitation (inch)	20.55	16.99

Monthly data collected from both stations indicate that most precipitation occurs in the early winter and late spring seasons. The month with the largest average precipitation over the time period was June, with 3.23 inches.

Based on data collected between 1992 and 2002 by the Western Regional Climate Center, prevailing winds in the area, as measured at Glacier Park International Airport, are generally from the south and south-southeast.

2.4 Geology

The following section describes the regional geology and Site-specific geologic features that exist beneath the Site.

2.4.1 Regional Geology

The Site is located within the northeast section of the Kalispell Valley, which is part of the larger Northern Rocky Mountain Physiographic Province (Fennemen, 1931). The Kalispell Valley runs northwest to southeast and is approximately 15 miles wide in the northern section near the Site. The Kalispell Valley was formed by late Paleocene to Eocene folding and thrust faulting combined with shaping of the valley by the middle Wisconsin Cordilleran and Alpine Glaciation (Konizeski et al., 1968). The Cordilleran Ice Sheet advanced south into the Kalispell Valley from the northwest corner near Whitefish, MT and combined with the Flathead Alpine Glacier originating in Glacier National Park east of the Site. Glacial recession resulted in the formation of glacial features in the valley including the Flathead River within the unconsolidated glacial drift.

The mountains bordering the Kalispell Valley are comprised predominantly of metamorphosed Precambrian sedimentary rock of the Ravalli group, lower belt series (Konizeski et al., 1968). The rock is typically gray to greenish-gray argillite and light gray quartzite.

2.4.2 Site Geology

The Site is situated approximately 1/2 mile northwest of Badrock Canyon, through which the Flathead River flows west and then south towards Flathead Lake. Teakettle Mountain is located on the east border of the Site and is comprised of primarily Precambrian sedimentary strata of the Ravalli Group. The stratigraphy immediately beneath the Site varies locally due to the heterogeneous nature of glacial and alluvial deposits. Alden (1953) suggests the area near Columbia Falls is underlain by primarily glacial till and lake sediments deposited by the Cordilleran Ice Sheet. In addition to these deposits, many valleys in western Montana contain glacial deposits derived from smaller, local glaciers (Hydrometrics, 1985). These deposits generally result in various mixtures of clay, sand, silt, cobbles and boulders.

A general geologic cross section depicting the subsurface stratum beneath the Site based on existing geologic boring logs is provided in Plate 2. Based on the cross section and Site well logs, glacial till, glaciolacustrine and glacial outwash deposits are inferred to exist beneath the Site. Recent alluvial deposits overlying the glacial stratigraphy are found to exist near the southern border of the Site, in the vicinity of the Flathead River. The existing geologic logs indicate that glacial till is prevalent in the northeast area near Teakettle Mountain.

Based on interpretation of the limited well logs from the Site, depth to bedrock is estimated to vary from 150 feet to greater than 300 feet across the majority of the Site depending on the proximity to the neighboring mountains and the Flathead River. In areas to the east of the Site near Teakettle Mountain, depth to bedrock is likely less than 150 ft. In the southern portion of the Site near the Flathead River, depth to bedrock may be significantly deeper than 300 feet.

2.5 Site Hydrogeology

The following section describes the regional and Site-specific features that dictate the surface water and groundwater flow in the region and the Site.

2.5.1 Surface Water Hydrology and Watershed Characteristics

The Site is located within the Flathead River-Columbia Falls watershed. The Site is bordered by surface water features on each side, including the Flathead River to the south, Cedar Creek to the west, Cedar Creek Reservoir to the north, and Cedar Creek Reservoir Overflow Drainage to the east.

Cedar Creek originates north of the Site in the Whitefish mountains and flows approximately three miles southwest towards the City of Columbia Falls. Based upon the flat topography of the portion of the Site located within one-half mile of Cedar Creek, there is little potential for surface water runoff from the Site into Cedar Creek. In addition, the elevation of Cedar Creek is higher than groundwater elevations within the Site, indicating that Cedar Creek is a losing stream rather than a gaining stream. According to the USGS National Hydrology Dataset, a tributary to Cedar Creek flows, or has flown historically, in the northern area of the Site, joining Cedar Creek approximately ½ mile to the southwest of the Industrial Landfill.

The Cedar Creek Reservoir Overflow Drainage flows intermittently in the spring and regulates flow for Cedar Creek and the Cedar Creek Reservoir (Hydrometrics, 1985). Based upon proximity and land surface topography, some surface water runoff from the eastern side of the Site, originating from the East and Sanitary Landfills, flows to the Cedar Creek Reservoir

Overflow Drainage. Similar to Cedar Creek, the elevation of Cedar Creek Overflow Drainage is higher than surrounding groundwater elevations within the Site, indicating that the Cedar Creek Overflow drainage is a losing stream.

The North Fork of the Flathead River originates in British Columbia and the Middle Fork of the Flathead River originates in the Bob Marshall Wilderness located south of Glacier National Park. The North Fork and the Middle Fork border Glacier Park on the western and southern boundaries, respectively, and flow south of Glacier National Park where they meet the South Fork of the Flathead River at the entrance of Badrock Canyon and the river is then called the Flathead River. The Flathead River flows west through Badrock Canyon towards Columbia Falls where its course is southerly to Flathead Lake (E&E, 1988). As of February 2015, the United States Geological Survey (USGS) maintains three active gauging stations on the Flathead River in the general vicinity of the Site. The closest station is located approximately three miles southwest of the Site near Columbia Falls (USGS Station #12363000). Two stations are located approximately 10 miles north/northeast of the Site: the north fork station on the Flathead River and the middle fork station immediately west of Glacier National Park (USGS Stations #s 12355500 and 12358500, respectively). Data collected in 2014 from the Columbia Falls USGS station indicated that the discharge of the Flathead River ranged from a minimum of 3,550~~00~~ft^3/s in ~~December~~ January to a maximum of 50,400 ft^3/s in May.

Groundwater in the region is typically recharged from the surface water sources within the watershed including numerous reservoirs, ponds, streams and lakes and additionally through infiltration of precipitation. Groundwater in the region may also discharge to surface water bodies. For example, during spring, the snowmelt and increased seasonal precipitation causes high flow in the Flathead River. This results in the Flathead River recharging groundwater and acting as a losing stream. In contrast, in the late summer, the dry weather results in a decrease in river stage so that the Flathead River becomes a gaining stream (Konizeski et al., 1968).

2.5.2 Site Hydrogeologic Units

In general, three hydrogeological units influence the flow of groundwater beneath the Site: Precambrian bedrock, Pleistocene glacial deposits and more recent alluvial deposits.

The Pleistocene glacial deposits that underlie the majority of the Site account for the main water bearing unit. The glacial deposits form a heterogeneous layer where porosity and permeability can change significantly locally. The boring logs from previous drilling within the Site suggest that lenses of high porosity, water bearing sand and gravel can range from a few feet thick to over a hundred feet (Hydrometrics, 1985). Aquifer testing conducted by Hydrometrics (1985) suggested groundwater yields of 555, 242, and 903 gallons per minute (gpm) from production wells PW-1, PW-3, and PW-5, which are screened within the glacial deposits.

Konizeski et al., (1968) suggested that the Pleistocene glacial deposits can be further divided into three distinct water bearing units, which they termed the Pleistocene Perched Aquifers, the Shallow Artesian Aquifer, and the Deep Artesian Aquifer. Review of the limited boring logs collected during previous investigations (Hydrometrics, 1985) suggest that the Pleistocene glacial sediments underlying the Site are typically coarse sands and gravels, with the presence of a glacial till unit to the north of the Main Plant Area (Plate 2). However, additional geologic borings would be required to delineate the presence of the three individual water bearing units discussed by Konizeski et al., (1968).

The Precambrian bedrock underlies the glacial deposits beneath the Site and across the valley. The bedrock has been metamorphosed over time, resulting in a tightly compacted, low porosity and low permeability unit. With the exception of bedrock fractures, little groundwater is typically found in the bedrock unit (Hydrometrics, 1985). The western flank of Teakettle Mountain, which forms the northeastern and eastern boundary of the Site, is essentially an outcrop of the Precambrian bedrock. The depth to bedrock, and in turn the thickness of the glacial deposits, increases in southwesterly direction away from Teakettle Mountain. However, most of the borings and wells completed at the Site did not encounter bedrock. Although the existing geologic data are insufficient to determine the bedrock surface topography across the Site, the available data indicate the depth to bedrock is likely greater than 300 feet in the vicinity of the Flathead River.

Alluvial deposits are present along the Flathead River floodplain. The alluvial deposits are typically permeable and capable of yielding sustained groundwater. Aquifer testing conducted by Hydrometrics (1985) suggested groundwater yields greater than 1000 gpm from production wells PW-4, PW-6, and PW-7, which are located close to the Flathead River and screened primarily within the shallow alluvial deposits.

2.5.3 Groundwater Occurrence and Flow

As part of the 2013 USEPA Site reassessment field activities, Weston Solutions collected groundwater elevations at 25 existing monitoring wells within and around the Site on September 24, 2013 (Weston, 2014). Depth to groundwater varied across the Site, from a minimum of approximately 14 feet below ground surface (bgs) in monitoring well W1-PW7 (approximately 100 feet north of the Flathead River) to a maximum of approximately 126 feet bgs in test well TW10, which is located between the South Leachate Pond and the Wet Scrubber Sludge Pond within the northeast portion of the Site.

Weston Solutions (2014) prepared a potentiometric contour map based on the groundwater elevations collected in September 2013 (Figure 4). Groundwater elevations suggest that regional groundwater flow is in the southwest direction across the northern two thirds of the Site and a south-southeast groundwater flow direction across the bottom southeast corner of the Site, adjacent to the Flathead River. The groundwater flow patterns indicated on the potentiometric contour map are similar to those described during previous investigations from Hydrometrics (1985) and Ecology & Environment, Inc. (1988).

2.6 Vegetation and Wildlife

Vegetation at the Site was described by Weston (2014) as consisting of coniferous forest and grasses characteristic of the Montana mountain environment. Pines, spruces, firs, grasses, and forbs are common at the Site. Ponderosa pine, Douglas fir, western larch, aspen, cottonwood, and maple trees, willow and common snowberry were identified during the 2013 field investigation (Weston, 2014).

A search of the U.S. Fish and Wildlife Service Environmental Conservation Online System (ECOS), available online at http://ecos.fws.gov/ecp/, suggests there are a total of seven threatened, endangered, or candidate species that may exist within the geographic area of the Site:

Species Type	Species Name	Species Status
Birds	Yellow-billed Cuckoo (Coccyzus americanus)	Threatened
Conifers and Cycads	Whitebark Pine (Pinus albicaulis)	Candidate
Fishes	Bull Trout (Salvelinus confluentus)	Threatened
Flowering Plants	Spalding's Catchfly (Silene spaldingii)	Threatened
Insects	Meltwater Lednian Stonefly (Lednia tumana)	Candidate
Mammals	Grizzly Bear (Ursus arctos horribilis)	Threatened
Mammals	Canada Lynx (Lynx canadensis)	Threatened

A search of the Montana Fish, Wildlife & Parks (FWP) (available online at http://fwp.mt.gov) indicates there are 37 different Animal Species of Concern found in Flathead County, Montana. ~~However, because the species of concern are listed by county, it cannot be definitely determined which species can be found within the Site boundary.~~ As discussed in Section 5.2.2, a Site-specific biological survey will be performed to determine the presence, or potential presence, of species of concern at the Site. The species of concern listed by the FWP include:

Species Type	Species Scientific Name	Species Common Name
Mammals	Corynorhinus townsendii	Townsend's Big-eared Bat
Mammals	Gulo gulo	Wolverine
Mammals	Lasiurus cinereus	Hoary Bat
Mammals	Lynx canadensis	Canada Lynx
Mammals	Myotis lucifugus	Little Brown Myotis
Mammals	Myotis thysanodes	Fringed Myotis
Mammals	Pekania pennanti	Fisher
Mammals	Sorex hoyi	Pygmy Shrew
Mammals	Synaptomys borealis	Northern Bog Lemming
Mammals	Ursus arctos	Grizzly Bear
Reptiles	Elgaria coerulea	Northern Alligator Lizard
Amphibians	Anaxyrus boreas	Western Toad
Amphibians	Lithobates pipiens	Northern Leopard Frog
Fish	Cottus rhotheus	Torrent Sculpin

Species Type	Species Scientific Name	Species Common Name
Fish	Oncorhynchus clarkii lewisi	Westslope Cutthroat Trout
Fish	Oncorhynchus mykiss gairdneri	Columbia River Redband Trout
Fish	Prosopium coulteri	Pygmy Whitefish
Fish	Salvelinus confluentus	Bull Trout
Invertebrates – I nsects	Euphydryas gillettii	Gillette's Checkerspot
Invertebrates – Insects	Rhyacophila ebria	A Rhyacophilan Caddisfly
Invertebrates – Insects	Rhyacophila glaciera	A Rhyacophilan Caddisfly
Invertebrates – Insects	Rhyacophila potteri	A Rhyacophilan Caddisfly
Invertebrates – Insects	Rhyacophila rickeri	A Rhyacophilan Caddisfly
Invertebrates – Insects	Coenagrion interrogatum	Subarctic Bluet
Invertebrates – Insects	Somatochlora walshii	Brush-tipped Emerald
Invertebrates – Insects	Parameletus columbiae	A Mayfly
Invertebrates – Insects	Isocapnia crinita	Hooked Snowfly
Invertebrates – Insects	Lednia tumana	Meltwater Lednian Stonefly
Invertebrates – Insects	Zapada cordillera	Cordilleran Forestfly
Invertebrates – Mollusks	Acroloxus coloradensis	Rocky Mountain Capshell
Invertebrates – Mollusks	Magnipelta mycophaga	Magnum Mantleslug
Invertebrates – Mollusks	Pristiloma wascoense	Shiny Tightcoil
Invertebrates – Mollusks	Prophysaon andersoni	Reticulate Taildropper
Invertebrates – Mollusks	Prophysaon humile	Smoky Taildropper
Invertebrates – Mollusks	Zacoleus idahoensis	Sheathed Slug
Invertebrates – Other	Salmasellus steganothrix	A Cave Obligate Isopod
Invertebrates – Other	Stygobromus glacialis	Glacier Amphipod

The ECOS search also suggests there are 19 migratory birds of concern present within the geographic area of the Site:

Species Name	Species Occurrence in Project Area
American Bittern (Botaurus lentiginosus)	Breeding
Baird's Sparrow (Ammodramus bairdii)	Breeding

Species Name	Species Occurrence in Project Area
Bald Eagle (Haliaeetus leucocephalus)	Year-round
Black Swift (cypseloides niger)	Breeding
Brewer's Sparrow (Spizella breweri)	Breeding
Calliope Hummingbird (Stellula calliope)	Breeding
Cassin's Finch (Carpodacus cassinii)	Breeding
Common Tern (Sterna hirundo)	Breeding
Fox Sparrow (Passerella liaca)	Breeding
Golden Eagle (Aquila chrysaetos)	Year-round
Grasshopper Sparrow (Ammodramus savannarum)	Breeding
Lewis's Woodpecker (Melanerpes lewis)	Breeding
Olive-Sided Flycatcher (Contopus cooperi)	Breeding
Peregrine Falcon (Falcon peregrinus)	Year-round
Rufous Hummingbird (selasphorus rufus)	Breeding
Short-eared Owl (Asio flammeus)	Year-round
Swainson's Hawk (Buteo swainsoni)	Breeding
Upland Sandpiper (Bartramia longicauda)	Breeding
Willow Flycatcher (Empidonax traillii)	Breeding

A search of the FWP indicates a variety of fish species are present in the Flathead River as of February 2015: Black Bullhead, Brook Trout, Brown Trout, Bull Trout, Kokanee, Lake Trout, Lake Whitefish, Largemouth Bass, Largescale Sucker, Longnose Dace, Longnose Sucker, Mottled Sculpin, Mountain Whitefish, Northern Pike, Northern Pike Minnow, Peamouth, Pumpkinseed, Pygmy Whitefish, Rainbow Trout, Redside Shiner, Slimy Sculpin, Smallmouth Bass, Westslope Cutthroat Trout, Westslope X Rainbow, and Yellow Perch.

Streamside wetlands provide potential habitat at the Site along the Flathead River (Montana National Heritage Program's (MNHP Wetland and Riparian Mapping database). The dominant vegetation near the wetlands is riparian lotic forested, intermixed with freshwater palustrine scrub-shrub and riparian lotic emergent wetlands, and pockets of riparian lotic scrub-shrub and freshwater palustrine emergent wetlands. These wetland types are also found onsite in the areas surrounding the North and South Percolation Ponds ~~at the southern end of the Site~~ and adjacent to the Flathead River, as shown on Figure 3.

2.7 Site History

This section provides an overview of the ownership and operational history of the Site.

2.7.1 Ownership History

According to available resources, the earliest noted developments at the Site were agricultural and residential. Industrial development began in the 1950s, when the Anaconda Copper Mining Company purchased the property in 1951 and built the existing aluminum reduction facility. The industrial ownership timeline for the Site is as follows:

- 1951 to 1978: Anaconda Aluminum Company
- 1978 to 1985: Atlantic Richfield Company
- 1985 to 1999: Montana Aluminum Investor's Corporation
- 1999 to present: Columbia Falls Aluminum Company, LLC

The south end of the Site includes the switch yard jointly owned by CFAC and Bonneville Power Administration and the mainline of the Burlington Northern Santa Fe Railway.

2.7.2 Operational History

Aluminum was produced at the Site from 1955 to 2009. The facility began with two potlines in 1955 and an annual capacity of 67,500 tons per year (using 120 pots per potline). A third potline was added in 1965, and the fourth and fifth potline were added 1968, increasing total aluminum production capacity at the Site to 180,000 tons per year.

During aluminum production, the Hall-Heroult process and the Vertical Stud Soderburg technology was used to reduce alumina into aluminum. Aluminum oxide was dissolved into sodium aluminum fluoride (cryolite) bath in a carbon-lined pot heated to 1760 °F (960 degrees Celsius). Electric current was run through a carbon anode made of petroleum coke and pitch, to a carbon cathode (the steel pot, firebrick liner, and a layer of carbon paste), reducing the aluminum ion to aluminum metal. The anode was consumed during the reaction, forming molten aluminum at the bottom of the pot. The molten aluminum was tapped from the pot and was blended to an alloy (depending on the customer's order). The aluminum was then transferred to the casting area, and cast into ingots as the finished product for shipment off-site.

A Rod Mill, in the southwest corner of the Main Plant Area, was also operated until the late 1960s. The Rod Mill was used to produce aluminum wire and cable. After its use as a Rod Mill, the building was used as a warehouse.

Raw materials, aluminum oxide, petroleum coke, coal tar pitch and fluoride/cryolite were delivered to the Site by rail. Alumina was delivered to the off-loading buildings, where the alumina was transferred to the silos between the potlines. Petroleum coke and coal tar pitch were delivered to the north side of the plant and mixed in the Paste Plant to form briquettes to be used as anodes.

The aluminum production process generated spent potliner (SPL). The sodium in the cryolite bath gradually penetrated the carbon paste lining of the pot, causing the carbon to swell and eventually fail. The lifespan of a cathode ranged from 5-14 years. To reuse the pot, the lining of the pot was removed and replaced. The potliner consisted of the thick layer of carbon bonded to an insulating brick layer, containing fluoride, sodium, aluminum and small amounts of cyanide. The fluoride and sodium in the SPL are from the sodium aluminum fluoride (cryolite) bath, and the cyanide forms in the cathode as a side chemical reaction during aluminum production.

From 1964 to 1978, SPL was removed by soaking the pots in pits filled with water (Hydrometrics, 1980). These pits drained to the North Percolation Ponds.

The aluminum production processes generated air emissions, including particulate fluoride, hydrogen fluoride and polyaromatic hydrocarbon compounds (PAHs). The main sources of air emissions were the Paste Plant and the aluminum reduction facility (USEPA, 1998). Air emissions from the electrolytic reduction process were controlled using wet scrubbers until the system was upgraded to dry scrubbers in the 1976 – 1978 timeframe. Air emissions from the Paste Plant were also controlled with a wet scrubber from 1955 to 1999. Waste-water from the

Paste Plant wet scrubbers was discharged to the North Percolation Ponds (CFAC, 2003). An analysis of the wet scrubber sludge by the Columbia Falls Plant laboratory staff indicated that the sludge was about 80% calcium fluoride on a dry weight basis, and also contained calcium oxide, magnesium oxide, sodium oxide and iron oxide (Hydrometrics, 1993). The sludge generated from the scrubbers was landfilled on Site.

Solid waste generated by the aluminum production process was primarily disposed in on-site landfills; SPL was disposed on-site until it was classified as a hazardous waste by EPA in 1990 and then it was shipped off-site for disposal as KO88 listed hazardous waste at permitted hazardous waste landfills. With the advent of RCRA hazardous waste regulations in the late 1970's, other wastes, when classified as hazardous waste, were shipped off-site for disposal at permitted facilities. At this time, records of hazardous waste shipments have been found starting in 1981. In addition to SPL and wet scrubber sludge, the on-Site landfills historically were used to dispose of other wastes such as: dross, potliner refractory wastes (non-hazardous- likely the scrap calcined petroleum coke, ore, cryolite, aluminum fluoride, bath, brick, concrete), scrap metal, wood, used oil, and municipal solid waste (MSW). The table below describes the years of operation and types of wastes reportedly disposed of at each landfill over time (CFAC, 2013; E&E, 1988; RMT, Inc., 1997). The location and boundaries of each landfill are shown on Figure 3. Additional discussion of each landfill is provided in Section 3.2.1.

Landfill Operation Summary

Landfill	Years of Operation	Construction	Type of Waste
West	1955 – 1981	Unlined Earth Cap 1981 Clay Cap 1992 Synthetic Cap 1994	SPL (1955 – 1970 only), sanitary, MSW, scrap (steel, wood, strapping, scrap from shops)
Center	1970 – 1980	Unlined Clay Cap	SPL, sanitary, scrap
East	1980 – 1990	Clay Liner Synthetic Cap	SPL (1980-1990)
Sanitary	1981 – 1982	Clay Liner Cap-type unknown	MSW, sanitary
Industrial	1970s – present	Unknown	Scrap metal, wood, MSW

Landfill	Years of Operation	Construction	Type of Waste
Wet Scrubber Sludge Pond	1955 – 1980; 1994 – 1998	Unlined Earth Cap 1981	Sludge from wet scrubber (until 1976), spent potliner leachate (1994 – 1998 only)
Asbestos (Northern)	1980s-2009	Unknown	Asbestos
Asbestos (Southern)	1980s	Unknown	Asbestos

Sources:
CFAC, 2013; RMT, 1997

During facility operations, wastewater generated as a result of the aluminum reduction process was discharged indirectly to groundwater. Ground Water Pollution Control System Permit Number MGWPCS0005~~MGP0005~~ was issued by the State of Montana on September 17, 1984, after noting that ground water under the plant might be contaminated with cyanide and fluoride from historic operations. The plant was permitted to discharge indirectly to the groundwater. In 1993, CFAC applied for MPDES permit for the groundwater, contaminated by historical spent potlining disposal practices, released to the Flathead River. Permit MT-0030066 was issued authorizing CFAC to discharge process wastewater from its aluminum reduction plant, to ground waters discharging to the Flathead River. The permit included special conditions requiring CFAC to cap the spent pot liner landfill and investigate Site hydrology to track the cyanide concentration in groundwater from the landfill to the Flathead River (MT-0030066). On February 1, 1999, the State of Montana issued MPDES Permit No. MT-0030066 which authorized CFAC to "discharge process wastewater and ground water containing wastewater from its aluminum reduction facility, to ground waters discharging to the Flathead River, …" (page 1 of 1999 Permit in Appendix C) Groundwater receives water from the North Percolation Ponds, the South Percolation Ponds, the West Percolation Pond, drywells and historical disposal practices. The permits and related documents are included in Appendix C.

A mixing zone in Montana means an area established in a permit where water quality standards may be exceeded, subject to conditions and rules of Montana Code Annotated 75-5-103(21). The extent of the mixing zones at the Site was illustrated in Exhibits 1 and 2 of Permit MT-0030066 in 1999 (see Appendix C). The groundwater mixing zone for cyanide and fluoride extends within a polygon defined by a point on the north bank of the Flathead River located 3630 feet west of well PW-7, extending northward 300 feet to the railroad tracks, then 31 degrees for a distance of 4,500 feet to the roadway along the northern edge of the West Landfill, following that roadway eastward to a second roadway adjacent to the Cedar Creek diversion ditch, then southeastward along the ditch roadway for 1930 feet, then southward for 3,500 feet along the fence line to the access roadway on the south side of the South Percolation Ponds, then westward along the pond access roadway to the point of origin. The surface water mixing zone consists of a segment of the Flathead River extending from a point on the north bank located 2,100 feet west of PW-7, westward to a point on the north bank located 4,600 feet west of well PW-7.

Details regarding the wastewater volume and composition at each outfall are included in Appendix C.

2.8 Previous Environmental Investigations and Cleanup Actions

The following sections provide an overview of previous environmental investigations and cleanup actions performed at the Site. Previous investigations have been performed by Hydrometrics, the Montana Department of Health and Environmental Sciences, the United States Environmental Protection Agency, Ecology and Environment Inc., Olympus Environmental Inc., RMT-Michigan Inc., and Weston Solution, Inc.

2.8.1 Evaluation of Potential Locations for the East Landfill – 1980

An environmental investigation was conducted to evaluate potential locations for a new hazardous waste landfill (later known as East Landfill). The investigation included a review of the regulatory framework for constructing a hazardous waste landfill, Site history, and an environmental investigation. The environmental investigation also included aquifer tests on wells, installation of piezometers, excavation of test pits, a well inventory, construction of a test well (TW-7), groundwater level measurements and collection of water quality samples. Test pits were excavated on the south end of the Site to facilitate soil mapping, and additional test pits were completed to examine soils at the existing landfills. Soil samples were collected from test pits, and nine piezometers were installed at test pits to evaluate shallow aquifers.

The installation of monitoring well TW-7 included drilling through the Center Landfill and collecting soil samples at depths below the landfill. Soil samples contained 0.006 to .016 mg/kg of cyanide and 0.4 to 2.0 mg/kg of fluoride. Groundwater from existing Site production and monitoring wells were also sampled including PW-4, PW-5, PW-6, PW-7, TW-1, TW-2, TW-3, TW-8, and TW-14. Cyanide concentrations ranged from 0.005 mg/L to 0.150 mg/L, and fluoride concentrations ranged from 0.10 to 11.0 mg/L. The highest concentrations of fluoride and cyanide were located at TW-2, (located near the West Percolation Pond) and were attributed to past use of cathode soaking pits.

The results of the environmental investigation were summarized in the 1980 "Site Location and Evaluation for Disposal of Hazardous Wastes at Columbia Falls Reduction Plant, Columbia Falls, Montana, Phase I Report" by Hydrometrics, Inc.

2.8.2 Preliminary Site Assessment – 1984

In March 1984, the Montana Department of Health and Sciences conducted a Preliminary Assessment of the Site. A copy of the report prepared for the Preliminary Assessment was not available for review by Roux Associates; however, the findings were discussed briefly in a subsequent report prepared by Ecology and Environment, Inc. (E&E, 1988). The E&E report indicated that hazardous wastes were generated onsite including spent halogenated and non-halogenated solvents. Solid wastes generated onsite included spent potliners, basement sweepings, and air pollution control dusts.

2.8.3 Hydrogeological Evaluation – 1985

A hydrogeological investigation was completed by Hydrometrics to satisfy requirements of the 1984 Montana Groundwater Pollution Control System Permit. The investigation evaluated the quality and quantity of groundwater beneath the Site, flow direction, and potential for off-site impacts as well as providing recommendations for waste management.

Groundwater elevations were measured from 1982 to 1985; results showed groundwater flow in a general southwest direction across the Site.

Water quality samples were collected on a quarterly basis from 1982 to 1985. Hydrometrics concluded that the Main Plant had a limited effect on groundwater and surface water in the vicinity of the plant. Measurable cyanide and fluoride concentrations were observed in groundwater in TW-1 and TW-2 (located downgradient of the North Percolation Ponds). Data shows a decreasing trend attributed to the cessation of cathode soaking pits. Fluoride concentrations above 1 mg/L (and low levels of cyanide [typically lower than 10 µg/L]) were observed in the North Percolation Ponds and South Percolation Ponds.

Hydrometrics concluded that no additional waste management practices were necessary for the Site. A summary of the investigation activities was provided in the Hydrometrics 1985 report entitled "Hydrogeological Evaluation ARCO Aluminum Primary Operation, Columbia Falls, Montana".

2.8.4 E&E Site Investigation Analytical Results Report – 1988

Ecology and Environment, Inc. (E&E) conducted an investigation to characterize hydrogeologic conditions beneath the Site, characterize the nature of contaminants at the Site, and quantify the possible release of contaminants off-site. The investigation scope included the collection of nine groundwater samples, five soil samples, seven surface water samples and nine sediment samples from the Site.

In November 1988, E&E submitted a report entitled "Analytical Results Report, Columbia Falls Aluminum Company, Columbia Falls, Montana, TDD F08-8809-12, CERCLIS MTD05756173" which summarizes E&Es conclusions and findings from the investigation, as summarized below:

- PAHs associated with plant processes were observed in soils and sediments. The highest concentrations were observed in the North and South Percolation Ponds, but do not appear to be released to the Flathead River.
- Cyanide was released to groundwater and surface water as a result of plant activities.
- One surface water sample of the Flathead River contained cyanide at a concentration of 55 ppb, directly downgradient of the South Percolation Ponds. The likely source of the cyanide was the South Percolation Ponds.
- Groundwater wells CF-MW-2 and TW-2 exhibited concentrations of 666 and 53 ppb of cyanide respectively. Other organic contaminants do not appear to have been released to groundwater.

After reviewing the report, the USEPA classified the Site as No Further Remedial Action Planned (Internal Correspondence from Ken Reick to Don Ryan, 2/16/1989).

2.8.5 PCB Remediation in Rectifier Yard – 1991

On September 10, 1991, there was a transformer fire in the west rectifier yard, resulting in the release of an estimated 4,000 gallons of dielectric fluid. Olympus Environmental completed the excavation of PCB-impacted soil in the west rectifier yard, and shipped the soil to an approved off-site disposal facility. The remediation was documented in a May 5, 1992, letter from John Binder (Olympus Environmental) to Don Ryan (CFAC) titled "Re: Site remediation of polychlorinated biphenyl contamination at Columbia Falls Aluminum Plant (CFAC)". As stated in the Site Reassessment Report (Weston, 2014) "the USEPA recommended no further cleanup".

2.8.6 Hydrological Data Summary Report – 1992

Hydrometrics was retained to summarize hydrological data for the Site collected since the 1985 Hydrogeological Evaluation and develop a compliance plan to meet discharge requirements for the seepage of shallow groundwater to the Flathead River. The scope of work performed by Hydrometrics included review and summarizing data from the 1985 Hydrogeological Evaluation report, the 1988 Analytical Results Report, data collected by CFAC from 1985 through 1991, and data collected by the Water Quality Bureau staff during a field investigation on 8/14/1991.

Data was summarized in the February 28, 1992 report titled "Hydrological Data Summary, Columbia Falls Aluminum Company Plant Site, Columbia Falls, Montana" by Hydrometrics, Inc. The conclusions from the Hydrological Data Summary report, as presented by Hydrometrics, are summarized below:

- The aluminum production has had a limited effect on surface and groundwater quality near the plant.
- There was a measurable increase in fluoride and cyanide downgradient of the North Percolation Ponds. The elevated fluoride and cyanide was attributed to discharge from cathode soaking pits, operating from 1964-1977. Concentrations of fluoride and cyanide have decreased over time, and are currently monitored under a MPDES permit.
- The South Percolation Ponds contain fluoride above 1 mg/L and minor cyanide concentrations (less than 10 µg/L). Routine sampling at the downgradient Flathead River has shown no measurable increase in fluoride or cyanide.

- Shallow groundwater containing cyanide was identified discharging to the Flathead River through seeps along bank of a backwater area located approximately 0.25 miles downstream of the South Percolation Ponds. Low levels (less than 10 µg/L) of cyanide were occasionally observed in the Flathead River backwater slough immediately downstream of the South Percolation Ponds. Since 1988, total cyanide concentrations were consistently below laboratory detection limits. Based upon the observed rate of seepage and measured concentrations, the seepage of shallow groundwater was characterized as posing little to no threat to human health and the environment.

2.8.7 Hydrological Conditions at the Closed Landfill, Sludge Pond, and Well #5 - 1993

An investigation was completed to determine sources of cyanide to the Flathead River and assess the potential to intercept groundwater before the Seep as requested by the Montana Department of Health and Environmental Sciences Water Quality Bureau. The scope of work included construction of TW-15 downgradient of the West Landfill and Wet Scrubber Sludge Pond, construction of TW-16 to evaluate hydrogeological conditions adjacent to the Seep, construction of TW-17 to intercept landfill leachate from the West Landfill, and additional groundwater sampling. The work was summarized in the August 23, 1993 Hydrometrics report titled "Assessment of Hydrological Conditions Associated with the Closed Landfill, Calcium Fluoride Pond and Production Well Number 5 at the Columbia Falls Aluminum Plan, Columbia Falls, Montana."

The conclusions from the assessment, as presented by Hydrometrics, are summarized below:

- The West Landfill was a source of cyanide to groundwater. Groundwater from TW-17 (downgradient of the West Landfill) had elevated cyanide, fluoride, pH and TDS.
- Groundwater aquifer testing indicated that groundwater from the north-central landfill area generally flows southeast toward well PW-5 (W-9).
- Cyanide concentrations decrease with distance downgradient of the West Landfill, toward the Seep along the Flathead River and PW-5 (W-9), indicating dispersion and dilution are occurring.

2.8.8 Second PCB Remediation in Rectifier Yard – 1994

In 1994, two capacitors in the West Rectifier Yard exploded, spilling 3 to 4 gallons of "pure PCBs" (1994 CFAC SWPPP). Impacted soil was removed and disposed of off-site. Impacted equipment was cleaned and analyzed for residual PCBs using wipe tests (1994 SWPPP;

Olympus, 1994). Post-removal soil samples analyzed for PCBs indicated total PCBs at concentrations ranging from 0.366 mg/kg to 24.0 mg/kg total PCBs (a limit of 25 mg/kg was used as this part of the Site was considered an "other restricted area") (Olympus, 1994).

2.8.9~~11~~ CECRA Priority List – 1989

MDEQ evaluated and listed the Site under Montana's mini-Superfund statute (Comprehensive Environmental Cleanup and Responsibility Act "CECRA"). The CECRA Priority List shows the Site ranked as "R" which means the site is referred to another program for regulation. The Site has been regulated by the Montana Ground Water Pollution Control System (MGWPCS) and the MPDES programs (Appendix C).

2.8.10 EPA Investigation – 1996

USEPA and MDEQ Water Quality Bureau inspected the Site in 1996 to determine the validity of the MPDES Permit MT-0030066. Flowing seeps were observed along the Flathead River, located south and east of the plant. EPA reported that the seeps continue along the river bank for over 1,000 feet and during high flow, many of the seeps would be covered up. EPA noted high levels of fluoride were found in sampling conducted in 1991. The report concluded the seeps were probably groundwater moving underneath the CFAC plant operation and the groundwater had been definitely affected by past operations and practices as evidenced by the levels of cyanide and fluoride.

2.8.~~9~~-11 Suspected SPL Removal from Wet Scrubber Sludge Pond Landfill – 1998

At the request of the State of Montana's Permitting and Compliance Division of Air and Water Management Bureau, CFAC removed pot diggings material disposed on the surface of the closed Wet Scrubber Sludge Pond in July, 1998 (Weston, 2014). Post excavation samples of the waste material and underneath the waste pile contained some detections of cyanide (highest concentration of 2.1 mg/kg) that were ~~in compliance with the~~below the 1998 USEPA residential risk-based criteria used for comparison at that time (1,600 mg/kg) (Weston, 2014) and below the current residential risk based screening level for cyanide (2.7 mg/kg). The State declared no further action in October, 1998.

2.8.12 EPA/MDEQ Waste Characterization Investigation – 2001

USEPA was concerned with hazardous waste streams from previous experience with another Montana smelter. Toxicity Characteristic Leaching Procedure (TCLP) samples were collected from numerous CFAC waste streams. However, no unexpected hazardous waste was found (CFAC, 2013).

2.8.13 CFAC Environmental Issues Investigation – 2003

Interviews with former and current employees were conducted in response to former employee allegations regarding historic disposal practices. A former employee allegedly observed groundwater in the West Landfill. This claim was not substantiated by interviews with other employees and work completed by Hydrometrics. A former employee also allegedly observed improper disposal of SPL north of production well 5 in the vicinity of the south asbestos landfill. Other former employees agreed that SPL was placed in the area, but it was subsequently removed. Upon inspection, several pieces of carbon were visible in the area.

2.8.14 USEPA Site Reassessment – 2014

In 2013, Weston Solutions, Inc. (Weston) completed an investigation at the Site on behalf of the USEPA Region 8. The results were summarized in the April 2014 report titled "Site Reassessment for Columbia Falls Aluminum Company Aluminum Smelter Facility, Columbia Falls, Flathead County, Montana prepared for United States Environmental Protection Agency Region 8." The Weston (2014) report states that the objectives of the investigation were to:

- Characterize the hydrogeological conditions at the Site.
- Evaluate source area(s) and contaminant characteristics of source area(s) at the Site
- Collect samples and associated analytical data to confirm a release, or threat of a release of a hazardous substance to the environment.
- Identify the contaminants of concern.
- Identify the potential targets or receptors (human and ecological) that may be impacted, and pathways by which they may be or are being transmitted.
- Determine if potential targets or receptors have potential or actual contamination.

As part of the investigation, groundwater elevations were collected with an oil/water interface meter. Depth to water at the Site ranged from approximately 14 feet below top of casing (btoc) in a monitoring well near the Flathead River (W1-P7) to 126 feet btoc in monitoring well TW-10 located near Teakettle Mountain in the northern portion of the Site. The average groundwater elevation at the Site was approximately 71 feet btoc. Weston utilized the groundwater elevations to prepare a Site-wide potentiometric contour map which was previously discussed in Section 2.5.3. The contours as presented by Weston (2014) are provided in Figure 4.

A total of 68 groundwater, surface water, sediment and soil samples were collected at the Site and surrounding areas during the investigation. The samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), total and dissolved Target Analyte List (TAL) metals, fluoride, and nitrate/nitrite as N (water samples only). Two groundwater, six surface water, seven sediment, and three surface soil samples were collected from locations considered as background. Analytical results were compared to three times the background concentration to establish if an observed release had occurred at the Site as that term is defined in the EPA Hazardous Ranking System Guidance Manual. Soil and sediment analytical results were also compared to risk-based screening criteria including the Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration (RDSC), Cancer Risk Screening Concentration (CRSC) and EPA Regional Screening Levels (RSLs). Surface water and groundwater sample analytical results were compared to Montana Numeric Water Quality Standards in addition to the aforementioned screening criteria.

The conclusions from the Site Reassessment Report, as presented by Weston, are summarized below:

- The on-site analytical samples indicated a release of metals and inorganics in groundwater, metals and inorganics in surface water, cyanide and fluoride in sediments and fluoride in soils greater than background levels and/or human health and/or ecological screening levels due to historic plant processes.
- Sources areas include the landfills and waste pond (groundwater) and the North and South Percolation Ponds (surface water and sediment).
- Residential groundwater wells indicate observed concentrations of some elements above background concentrations, but only cyanide (at a concentration of 111 µg/L and

18.5 μg/l) exceeded the USEPA Tapwater RSL human health screening level. These concentrations were detected in one Aluminum City well and in another well located north of the Site near Cedar Reservoir. The cyanide concentrations were below the USEPA MCL of 200 μg/L.

- Cyanide exceeded the background concentration and all of the Superfund Chemical Data Matrix (SCDM) benchmarks and Montana Department of Environmental Quality (MDEQ) Aquatic Life water quality standards (WQS) ~~benchmarks~~ in a Cedar Creek surface water sample.

- Manganese, sodium, zinc and fluoride exceeded three times the background level in Flathead River surface water. Cyanide and fluoride exceeded the three-times the background concentration in the Flathead River sediment.

- Soil samples containing fluoride concentrations above three-times the background level were observed on Site.

- Limited VOCs were detected in the groundwater samples at low concentrations (i.e., the maximum concentration detected was ~~of~~ 6.2 μg/L).

- Based on readily available information regarding current potential receptors and the limited soil sampling performed as part of this investigation, the potential impact to soil and air exposure pathways appears to be low.

USEPA tables summarizing historical landfill operations indicated that solvents were known to have been disposed in some of the Site landfills. However, none of the documents or information reviewed during preparation of this RI/FS Work Plan provides any evidence of such disposal.

2.8.15 Residential Water Well Sampling – 2014 and 2015

Four rounds of residential well-water sampling have occurred following the 2013 sampling that was conducted as part of the Site Reassessment (which as discussed above included one exceedance of the USEPA Tapwater RSL for cyanide in the residential wells). Sampling rounds were conducted in April 2014 (20 wells sampled) and November 2014 (ten wells sampled) by Weston on behalf of EPA; and in June 2015 (nine wells sampled) and September 2015 (ten wells sampled) by Hydrometrics on behalf of CFAC. Results are summarized as follows and are also discussed in Section 3.1.3:

- Cyanide was non-detect in all samples collected during the four rounds of residential water well sampling (with laboratory detection limits ranging between 5 and 10 μg/L).

- Fluoride was detected in five drinking water wells during the April 2014 sampling round. However, all fluoride concentrations were less than 190 µg/L, compared to the Tapwater RSL of 620 µg/L and the MT Circular DEQ-7 human health standard ~~HSL~~ of 4,000 µg/L.

- Fluoride was detected in one well during the June 2015 sampling round, and in two wells during the September 2015 sampling round. The maximum concentration was 140 µg/L, compared to the Tapwater RSL of 620 µg/L and the MT Circular DEQ-7 human health standard ~~HSL~~ of 4,000 µg/L.

2.8.16 Whole Effluent Toxicity (WET) Testing

~~In addition to the residential well sampling and a~~As a condition of its MPDES permit, CFAC conducted Whole Effluent Toxicity (WET) Acute Toxicity Testing of the Seep and Flathead River in 2014 and 2015. The Seep is indicative of groundwater discharging along the bank of the Flathead River, prior to any dilution or mixing with surface water in the Flathead River. WET testing occurs at a laboratory and entails placing test organisms (Ceriodaphnia dubia and Fathead Minnow) into the water samples and evaluating the survival of the test organisms over a prescribed period of time. All of the Seep samples and all of the Flathead River surface water samples passed the WET tests, therefore indicating no acute toxicity was observed under the conditions of these tests. The WET test data is provided in Appendix C.

3.0 INITIAL EVALUATION

This section provides Roux Associates' initial evaluation of the existing environmental data for the Site. The data are first summarized, and then a preliminary conceptual site model (CSM) is presented. The CSM identifies areas of concern at the Site, describes the potential migration and exposure pathways for Site contaminants, and provides a preliminary assessment of human health and environmental impacts associated with the Site contaminants. Based on the CSM, potential remedial action objectives and preliminary remedial action alternatives are identified for the Site. Lastly, this section provides a preliminary identification of potentially applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) information.

Roux Associates' initial evaluation of the existing Site data included (i) a Site visit conducted on September 30 and October 1, 2014, to gain familiarity with various Site features and to identify relevant Site records for review, (ii) review of existing aerial photography for the Site, (iii) review of published information regarding the Site and Site area, (iv) review of the results of previous Site investigations and cleanup actions, (v) assessment of the quality of the existing results, (vi) Site reconnaissance conducted on June 9 and 10, 2015, and (vii) interviews and discussions with current and former employees.

3.1 Summary of Existing Data

As discussed in Section 2.8, a number of investigations and cleanup actions have been performed at the Site in the past. This section summarizes Roux Associates' understanding of the existing environmental conditions at the Site based on its review of the existing data developed during these investigations and cleanup actions, along with historical aerial photography and other sources of information (e.g., published reports) regarding the Site and Site area.

3.1.1 Aerial Photography Review

Roux Associates performed a review of historic aerial photographs covering the Site and the surrounding properties. The review was performed to evaluate historic use of the Site and surrounding properties.

Fifteen standard aerial photographs and two stereographic pairs of aerial photographs dating from 1946 to 2013 were reviewed. Information regarding the specific aerial photography is provided in the table below. Interpretation of the stereographic pair was achieved using the 3X and 8X magnification lenses of a Sokkisha Model MS-27 stereoscope. Standard aerial photographs were reviewed in digital format, using ArcGIS.

Aerial Photography Reviewed

Flight Date	Scale	Photo Source	Comments
9/11/1946	1:27700	EDR	Standard
9/6/1956	1:38800	EDR	Standard
1961	1:20000	EDR	Stereo pair
8/7/1963	1:42000	EDR	Standard
1972		CFAC	B&W Aerial Image, Poor clarity
6/14/1974	1:40000	EDR	B&W Stereo Pair, Average clarity
8/8/1978	1:80000	EDR	B&W Aerial, Poor Clarity
1979	1:40000	EDR	B&W Stereo Pair, Average Clarity
7/271982	1:58000	EDR	B&W Aerial, Poor Clarity
6/6/1989	1”=2000’	CFAC	Standard
8/30/1991	1:40000	EDR	Standard
8/22/1995	1:40000	EDR	B&W Aerial, Poor Clarity.
1998		CFAC	Color Aerial, Average Clarity
9/27/2003	1:40000	EDR	B&W Aerial, Poor Clarity
2005	1:12000	EDR	Color; Standard
2009	1:12000	EDR	Color; Standard
2013	1:12000	EDR	Color; Standard

Key observations from the aerial photography review are presented in the following paragraphs and Aerial photographs are provided in Appendix A.

As shown in the 1946 aerial, prior to use as an aluminum reduction plant, the Site was largely undeveloped. Human disturbance and alteration of the landscape were visible in the form of altered forests, agriculture, and multiple small paths. A few residences were visible on the western side of the Site.

Early infrastructure at the plant (1956 aerial) included four pot rooms on the west side of the plant, the casthouse, machine shop, warehouse, office with parking lot, the Paste Plant, coal tar pitch tanks, compressor house, and western rectifier. The additional four pot rooms and the Rod Mill (also called the rod casting facility) were first visible on the 1972 aerial, consistent with historical accounts of facility expansion in 1965 and 1968.

Railroad tracks were present starting in 1956. As described in historical accounts, rail was a significant method of shipping and transportation for the facility. Railroad tracks were expanded to their present locations by 1974.

Overall, aerial photography confirmed the documented operational timelines for the Wet Scrubber Sludge Pond, the Center Landfill, and East Landfill. The West Landfill appeared to begin operations later than the 1955 date described in several reports (Weston, 2014, RMT, 1997); very minimal disturbance was observed in the 1956, 1961, and 1963 aerial photographs. However, it is likely that the aluminum reduction facility started operating with all new pots; thus, assuming historical pot replacement rates, it would have taken 5-7 years of operations to start generating SPL.

One of the two areas identified as asbestos landfills in the 2014 Site Reassessment Report are clear on the aerial photography starting in the 1980s. The area identified as the Southern Asbestos Landfill is visible in the 1974 aerial, and appears to be in use in the 1979 aerial, contradicting the 2014 Site Reassessment Report, which states that the asbestos landfills were likely active in the 2000s. The location of the Northern Asbestos Landfill and its period of use are not clear on aerial photography; however, disposal records indicate that northern asbestos landfill was in use from 1993 to 2009 (CFAC, 2009).

The industrial byproducts area (as noted in the Site Reassessment Report [Weston, 2014]) appears to be a highly sloped area with a road at the top. The historical aerial photo review did not identify any indication of disposal practices for the vast majority of the area. Only the northwestern corner of the areas (at the bottom of the slope) shows ground disturbance (1979 aerial). Significant erosion of the slope is visible in the 1983 aerial.

The areas adjacent to, and between, the landfills and the Main Plant were used to store a variety of materials over time. In addition, many materials were staged to the east of the plant before the eastern four pot rooms were built (1956 aerial). A 1980 CFAC hazardous waste permit identified a hazardous waste drum storage area west of the Wet Scrubber Sludge Pond, and stored material is visible in aerial photography from the 1980s. The area also shows various patterns in truck traffic and staged materials and equipment dating back to 1956.

The North-East Percolation pond was visible on the 1956 aerial. The 1963 aerial shows a ditch from the North-East Percolation Pond to the forested area northwest of the pond, which indicates that the area northwest of the North-East Percolation Pond may have served as an overflow before the North-west percolation pond was built. The North-West Percolation Pond appears to be in the process of being constructed in the 1972 aerial, and the two ponds were connected via a drainage channel, flowing east to west in the 1974 aerial.

The West Percolation pond is first visible in the 1980s, following the expansion of the main parking lot west of the reduction plant.

3.1.2 Hydrogeologic Data

The vast majority of Site-specific hydrogeologic data was generated during investigations conducted by Hydrometrics on behalf of CFAC to satisfy MGWPCS and MPDES permit requirements. As presented in Section 2.8, these investigations were conducted from the early 1980s thru the mid-1990s. The types of data available from these investigations include, but are not limited to:

- Geologic boring logs from installation of 17 monitoring wells and seven production wells;
- Estimates of hydraulic conductivity from pump tests at various monitoring wells and production wells; and
- Groundwater elevations and corresponding groundwater flow maps for various water level measurement dates.

A summary of the existing wells at the Site based on historical records is provided in Table 1. Note that in previous investigations the various consultants have identified the wells using different well ID numbers. Table 1 includes a column to indicate well IDs that have been utilized in prior investigations and those used in the USEPA Site Reassessment (Weston, 2014). Historical well logs available for review are included in Appendix D.

The available geologic logs from the existing monitoring wells and production wells were used to develop the current understanding of the Site hydrogeology described in Section 2.5. However, the drilling methods used for installation of the existing wells required that lithology be inferred based upon examination of drill cuttings rather than core samples. As a result, the lithology descriptions are generalized and may not fully reflect the heterogeneities of the subsurface conditions at the Site. Additionally, the existing monitoring wells are typically screened within the glacial sediments and bridge the water table. As a result characterization of the deeper overburden deposits and depth to bedrock across the Site is based upon data from just a few locations.

The monitoring wells that have been installed as part of the previous Site investigation are generally located around critical Site features. The data obtained from the well network provides a limited number of points to infer regional groundwater flow. However, as described in Section 2.5, the complex heterogeneity of the glacial deposits suggest that groundwater flow can be influenced locally based on the presence of localized high or low permeability lenses, and bedrock surface topography. Additional monitoring locations are required to further evaluate the influence of local high/low permeability areas and those areas of the Site where monitoring wells don't exist. Additionally, clustered monitoring wells can be used to evaluate the vertical component of groundwater flow, which has not been investigated at the Site.

3.1.3 Groundwater Quality Data

Groundwater quality at the Site has been evaluated on an ongoing basis since 1982 through the collection and analysis of groundwater samples from the well network discussed in the prior section. The majority of the work was conducted to support development of permit applications and to satisfy permit requirements for waste and wastewater disposal at the Site.

Hydrometrics (1985) indicated that quarterly groundwater samples were collected from select test and production wells starting in 1982. Results identified that measurable fluoride and cyanide concentrations were observed in wells immediately downgradient of the North Percolation Ponds and South Percolation Ponds. Trends of fluoride and cyanide were evaluated by Hydrometrics to determine if concentrations changed over time. Hydrometrics (1985) noted groundwater quality improved based on evaluation of the trends since the quarterly monitoring commenced. The results of the sampling described by Hydrometrics (1985) suggest that groundwater quality began to improve soon after cathode soaking operations ceased.

Weston, on behalf of the USEPA, collected groundwater samples as part of the Site reassessment field activities. Weston (2014) indicated that samples were collected to characterize groundwater conditions around important Site features. Groundwater samples were collected from existing Site monitoring wells and no additional monitoring wells were installed as part of the efforts. A total of 11 onsite monitoring wells and one upgradient monitoring well were sampled during the investigation. Additionally, four residential water supply wells located west of the Site in a residential area of Columbia Falls, and one residential well north of the Site were sampled and analyzed.

The data from the USEPA Site Reassessment (Weston, 2014) and the Site operational history indicate that cyanide and fluoride are two of the key contaminants of potential concern at the Site. Groundwater concentration data for cyanide and fluoride collected during the 2013 Site Reassessment are plotted on Figures 5 and 6 respectively. Results indicate that the highest concentrations of both cyanide and fluoride in groundwater were immediately southwest (i.e., downgradient) of the Wet Scrubber Sludge Pond and West Landfill areas. Results indicate that cyanide and fluoride concentrations in this area exceed the Maximum Contaminant Levels (MCLs) (USEPA, 2014) and Montana Department of Environmental Quality (MDEQ) Numeric Water Quality Standards (WQS) and Human Health and Aquatic Life Standards (MDEQ, 2012).

In addition to the recent sampling performed as part of the Site reassessment activities, groundwater conditions have been monitored on an ongoing basis since the mid-1980s pursuant to the MPDES permit. ~~and in general have maintained an overall good record of compliance.~~ The historical groundwater samples were typically collected bi-annually, and sometimes more frequently, at permitted locations. Sample data from the MPDES outfall locations are available in Site records from as early as 1994 through 2014. For this Work Plan, trends were reviewed to evaluate potential concentration changes over time near important Site features, including well locations near potential source areas.

Overall, data trends suggest a general decreasing trend in cyanide and fluoride concentrations from 1998 to 2014. For example, at monitoring well W-11 (Figure 7), which is located immediately west of the West Landfill/Wet Scrubber Sludge Pond and identified as a "source location" on the Site MPDES permit, cyanide and fluoride concentrations have exhibited an overall decreasing trend from 1998 to 2014. While the overall trend is decreasing, the monitoring data also indicate scatter that may be attributable to seasonal variations or the influence of precipitation events. Monitoring wells that are located further downgradient from potential source areas have demonstrated significantly lower concentrations than those located near areas identified as "source areas" on the permit.

In November 2013, as part of the 2013 Site Reassessment activities, Weston collected groundwater samples from four residential water supply wells located within the residential area west of the Site. Cyanide was detected in one well at a concentrations of 111 µg/L; which is less than the USEPA MCL of 200 µg/L. Additionally, a residential water supply well located north of the Site at a residence on the north shore of Cedar Creek Reservoir was sampled and cyanide was detected at a concentration of 18.5 µg/L. In April and November 2014, Weston sampled 20 wells and ten wells, respectively, from within the residential area (including one of the wells with prior cyanide detections). In June 2015 and September 2015, Hydrometrics on behalf of CFAC sampled nine and ten wells, respectively, from within the residential area. Cyanide was not detected in any of the wells during the 2014 and 2015 sampling events. In addition, all other analytes evaluated as part of the residential well sampling, including fluoride, VOCs, SVOCs, metals, pesticides and PCBs, were either not detected or present at concentrations less than applicable drinking water standards (i.e., the MDEQ WQS for Human Health and USEPA MCLs).

Overall, the groundwater quality data collected to date indicate that COPCs (i.e., cyanide and fluoride) are present in the proximity of the source areas; however, concentrations typically decrease as the distance from the source areas increases. Historical data trends suggest that groundwater quality data has improved over time due to improvements in Site practices (i.e., discontinuation of cathode pit soaking operations) and installation of engineering controls (i.e., caps) on landfills. The groundwater samples collected to date from the residential wells indicate that concentrations of site-related COPCs are below applicable groundwater and drinking standards within the residential area (i.e., the MDEQ WQS for Human Health and USEPA MCLs).

3.1.4 Surface Water Quality Data

Surface water samples were collected by Weston, on behalf of the USEPA, as part of the 2013 Site reassessment field activities. Samples were collected from a total of 15 locations. Four of the 15 samples were collected from the on-site percolation ponds (Two from the North Percolation Ponds and two from the South Percolation Ponds), which served as permitted waste disposal facilities as part of the MPDES for the Site. Surface water data collected from the percolation ponds indicate the detection of SVOCs, metals, and fluoride above the method detection limit. Additionally, surface water data from the percolation ponds were compared to the SCDM Acute and Chronic guidance values and the Montana Aquatic Life Acute and Chronic ~~guidance values~~standards when available. Analytes with concentrations exceeding these ~~guidance~~ values were observed in all four percolation pond samples. The analytes exceeding the ~~guidance~~ values included: aluminum, cyanide, copper and zinc.

Five of the 15 samples were collected from other surface water locations within the Site, including four from the Flathead River and one from Cedar Creek. The Weston 2014 report stated that surface water samples collected from the Cedar Creek indicated the detection of copper, cyanide, and potassium; however, only cyanide concentrations exceeded one or more of the aquatic life ~~guidance values~~standards. The Weston 2014 report stated that surface water samples collected from the Flathead River indicated limited detections of metals including manganese, sodium, and zinc, and fluoride and cyanide.

Five of the samples were collected as background samples at locations upgradient and outside of the area of potential impacts from the Site including one background sample collected north of the Site in Cedar Creek and four background samples collected from the Flathead River east of the Site.

In addition to the recent sampling performed as part of the Site reassessment activities, surface water was monitored at select locations within the Site as part of the MPDES process. Data from Flathead River sampling location RIV-2 (Figure 8), which is located near the identified Seep area on the Flathead River, indicate an overall decreasing trend in cyanide concentrations. The concentrations fluctuate and occasionally exceed MDEQ numeric water quality standards contained in Circular DEQ-7 (MDEQ, 2012). However, data from the downstream mixing zone monitoring point, sample location RIV-M (Figure 9), indicate cyanide has not been detected within the main stem of the Flathead River for all samples collected since 1998.

Overall, the surface water quality data collected within source area permitted waste disposal facilities (i.e., percolation ponds) indicate that COPCs (i.e., cyanide and fluoride) are present within surface water in these source areas. Surface water data collected within the Flathead River generally indicate no exceedances of water quality standards~~ or guidance values~~, with the exception of the 1999 permitted mixing zone around the identified seepage area. An acute mixing zone for cyanide was not granted in the 2014 renewal; however, this issue is currently under appeal.

Limited sampling has been conducted in Cedar Creek and Cedar Creek Drainage Overflow to characterize the surface water conditions.

3.1.5 Sediment Data

Sediment samples were collected by Weston, on behalf of the USEPA, as part of the 2013 Site reassessment field activities. Sediment samples were generally located in the same locations as surface water samples. Background sediment samples were collected upgradient of the Site in Cedar Creek and the Flathead River. Site sediment samples were collected from the surface water drainages on the east and west sides of the Site and waste sediment samples were collected from percolation ponds associated with the former plant operations. Sediment samples were also collected from the Flathead River downgradient of the Site to evaluate potential migration of sediment to the river.

Sediment samples collected in both the North and South Percolation Ponds indicated detections of multiple SVOCs, metals and fluoride above background levels. The sediment samples also included detections of pesticides in both the North and South Percolation Ponds. However, historical records show no indication of the use of pesticides at the Site, other than routine pesticides that may have been utilized for maintenance in the Main Plant Area~~, suggesting the pesticide detections are not likely related to historical operations.~~. Additionally, the data validation performed on the pesticide data presented in the Weston (2014) report indicates that all sample results are estimated and many were rejected during the data validation process~~, suggesting the detections may be a result of lab or other interferences.~~.

Sediment samples in the downgradient Flathead River samples indicated detections of cyanide and fluoride above background levels observed in upgradient river samples. None of the sediment samples collected in the surface water drainages on the east and west sides of the Site had sample results that exceeded the background levels.

3.2 Site Features and RI Areas

The Site operational history and results of prior investigations were evaluated as part of the RI scoping process to identify key Site features for further investigation as part of the RI. These Site features were divided into six RI focus areas (RI Areas) based upon whether they are potential source or release areas associated with historical manufacturing and waste disposal practices, areas potentially associated with waste disposal, and/or general categories of environmental media. Grouping of Site features into categories is beneficial when scoping data requirements and investigation strategies. Multiple Site features are similar in terms of physical characteristics, potential COPCs and release mechanisms, or location within the Site and therefore may require similar strategy. The six RI Areas include:

- Landfills and Leachate Ponds;
- Percolation Ponds;
- The Main Plant Area;
- Operational Area Soils;
- Site-wide Groundwater; and
- Surface Water Features.

A description of the Site features included within each of the RI Areas is provided below based upon review of previous reports, observations during an initial Site visit, and results of aerial photography review.

3.2.1 Landfills and Leachate Ponds

Landfills operated at the Site from 1955 to present, and were utilized for disposal of a variety of wastes, including SPL from 1955 to 1990. Other wastes reportedly disposed in landfills include solvents, municipal solid waste, sanitary waste, scrap metal and construction debris. Leachate ponds were also constructed adjacent to the landfills. The landfill and leachate ponds are described in detail in the following subsections.

3.2.1.1 West Landfill

The West Landfill comprises approximately 7.8 acres, with areal dimensions of approximately 615 feet by 600 feet (Figure 3). The landfill reportedly is unlined, extends approximately 35 feet below surrounding grade (CFAC, 2013), and rises approximately 13 feet above grade on the eastern side of the landfill, and over 30 feet above grade from the western side. Comparison of the reported landfill depth with water level elevations in adjacent monitoring wells indicates the base of the landfill is approximately 71 feet above the groundwater table. Landfill gas vents are present within the West Landfill.

The West Landfill was used to dispose of SPL and other wastes (sanitary, industrial, and reportedly solvents) from 1955 to 1980, though SPL disposal ended in 1970. The landfill was closed in 1980 and capped with a synthetic (hypalon) cap in 1994 (CFAC, 2013). Available documents do not provide details on cap construction or installation. It is estimated that 64,122 tons of SPL were disposed of at the West Landfill (CFAC, 2013).

Although the West Landfill is currently capped with a synthetic cap, the landfill operated for many years without a liner and was originally closed without an impermeable cap. Under those conditions, infiltration of precipitation through the landfill would have generated landfill leachate that could impact groundwater.

Groundwater monitoring wells downgradient of the West Landfill (TW3, W11 [CF-GW-MW-03 in Weston 2014 report], W3 [CF-GW-MW-04 in Weston 2014 report], W4, W5 [CF-GW-MW-05 in Weston 2014 report]) contain the highest concentrations of fluoride and cyanide observed on Site). The maximum concentration of cyanide measured in groundwater during the 2013 Site Reassessment was an estimated 1,040 µg/L at W3 (CF-GW-MW-04 in Weston report), and the maximum concentration of fluoride was 190,000 µg/L at W11 (CF-GW-MW-03 in Weston report).

3.2.1.2 Wet Scrubber Sludge Pond

The Wet Scrubber Sludge Pond is a landfill that is approximately 10.8 acres in size with areal dimensions of approximately 750 feet by 580 feet (Figure 3). Based on the documents reviewed, the depth of landfilled material is unknown.

The Wet Scrubber Sludge Pond received waste material from the wet scrubbers at the aluminum reduction plant from 1955 until 1980, at which time the wet scrubbers for the aluminum reduction plant were replaced with dry scrubbers which produce much less waste (Phase I, 1997). Studies of scrubber sludge indicated that the sludge is 80% calcium fluoride (CaF_2) on a dry weight basis, with small amounts of calcium oxide (CaO), magnesium oxide (MgO), sodium oxide (Na_2O), and iron oxide (Fe_2O_3).

The wet scrubber sludge pond was unlined, and operated from 1955 to approximately 1980. The pond was subsequently capped with an earthen cap in 1981 and vegetated.

~~Pot digging material was placed on top of the closed Wet Scrubber Sludge Pond in 1993/1994.~~ In February 1998, the State of Montana's Permitting and Compliance Division of the Air & Water Management Bureau requested that CFAC remove spent potliner material present in the Wet Scrubber Sludge Pond Landfill (Weston, 2014). The material disposed on the closed Wet Scrubber Sludge Pond was subsequently removed and disposed off-site in July, 1998 (Weston, 2014). Post excavation samples of the waste material and underneath the waste pile contained some detections of cyanide; however, the cyanide was several orders of magnitude less than the USEPA Region III Residential Risk-Based Criteria at the time (1600 mg/kg) (Weston, 2014) and was less than the current residential risk-based soil screening level of 2.7 mg/kg.

Groundwater wells directly downgradient of the Wet Scrubber Sludge Pond include W11, W3, W4, W5, and W6. W11, W3, W4 and W5 are also downgradient of the west landfill, and as stated in Section 3.1.3, these wells contain the highest concentrations of fluoride and cyanide observed on Site.

3.2.1.3 Center Landfill

The Center Landfill is approximately 1.8 acres (Figure 3) in area, in a circular shape, with an aerial diameter of approximately 330 feet. The landfill was constructed above grade, and is approximately 15 feet high. The landfill is approximately 91 feet above the groundwater table (CFAC, 2013). The Center Landfill was also referred to as the carbon pile.

The landfill was unlined. The Center Landfill was reportedly used to dispose of SPL, solvents, sanitary and scrap from 1970 to 1980. The landfill was closed in 1980 and likely capped with a clay cap (details are unknown). It is estimated that 69,745 tons of SPL were disposed of at the Center Landfill (CFAC, 2013).

Groundwater monitoring wells downgradient of the landfill (TW14 and TW8) were not sampled during the 2014 Site Reassessment Report.

3.2.1.4 East Landfill

The East Landfill encompasses an area of approximately 2.4 acres. The aerial dimensions are approximately 330 feet by 730 feet. The East Landfill was constructed above ground level (CFAC, 2013), and is approximately 30 feet above the surrounding grade. The groundwater table is approximately 124 feet below the east landfill.

The landfill was built with a clay liner and two lined leachate collection ponds. The landfill was operated from 1980 to 1990 for disposal of SPL (some former employee sources say SPL was shipped to a Washington State landfill from 1985 to the mid-1990s [CFAC, 2013]). An estimated 32,521 tons of SPL was disposed in the east landfill (CFAC, 2013). The landfill was closed in 1990 and capped with a synthetic cap.

Groundwater well TW-10 is located downgradient of the East Landfill. Sampling during the 2013 Site Reassessment activities indicated that only fluoride exceeded the three-times background concentration (400 µg/L) and the concentrations of metals were less than the surrounding wells.

3.2.1.5 North Leachate Pond

The North Leachate Pond is approximately 0.6 acres in size, with aerial dimensions of approximately 250 feet by 115 feet (Figure 3).

The North Leachate Pond was lined with hypalon liner. The North Leachate Pond received stormwater runoff and leachate from the East Landfill, and was hydraulically connected to the Wet Scrubber Sludge Pond by a drainage pipe. The pond was aerated to reduce concentration of cyanide. At the time of closure the pond contained cyanide at 0.44 mg/L and fluoride at 487 mg/L (Ryan, 1994).

The pond was closed in 1994 by draining approximately 400,000 to 500,000 gallons of leachate to the Wet Scrubber Sludge Pond (Ryan, 1994).

3.2.1.6 South Leachate Pond

The South Leachate Pond is approximately 0.9 acres in size. The South Leachate Pond received stormwater runoff and leachate from the east landfill.

The South Leachate Pond was lined with hypalon liner. Similar to the North Leachate Pond, the South Leachate Pond was aerated to reduce concentrations of cyanide. (CFAC, 1994; CFAC, 2003)

The pond was emptied in 1990 by draining approximately 150,000 gallons of leachate to the Wet Scrubber Sludge Pond containing 3 mg/L cyanide (Weston, 2014). The leachate pond was dried, capped and closed in 1993.

3.2.1.7 Sanitary Landfill

The Sanitary Landfill is approximately 3.8 acres in size, approximately 330 feet wide by 540 feet long (Figure 3). Groundwater in the vicinity of the Sanitary Landfill is located at approximately 60 feet below grade based on the levels in monitoring well TW-9.

Depth of landfill material is unknown and exact dates of operation are unknown. Based on aerial photography review, the Sanitary Landfill operated in the early 1980s. The landfill was reportedly clay lined, and was used for plant garbage (RMT, 1997). Some sources report solvents and hazardous waste were also buried in the landfill (E&E, 1988). According to the 2014 Site Reassessment Report, the landfill was covered with clean fill and vegetated.

The groundwater monitoring well TW-9 is downgradient of the sanitary landfill. During the 2013 Site Reassessment, the only exceedance of Montana Human Health or SCDM goals was for lead at an estimated 59.3 μg/L (above Montana Human Health Criteria and the SCDM MCL/MCLG of 15 μg/L).

3.2.1.8 Industrial Landfill

The industrial landfill is an active landfill in the northern part of the Site, encompassing approximately 12.4 acres (Figure 3). The aerial dimensions of the landfill are approximately 720 feet by 800 feet, though the shape is irregular. Depth to groundwater in the vicinity of the landfill is unknown. There are no monitoring wells downgradient of the industrial landfill.

The industrial landfill began operations in the 1980s (based on aerial photography). The industrial landfill receives non-hazardous waste and debris (CFAC, 2013). Details regarding the depth of landfilled material or presence of a liner are unknown.

3.2.1.9 Asbestos Landfills

Two areas are suspected of being asbestos landfills based on the information provided in the 2014 Site Reassessment Report (Weston, 2014). The extent of the south asbestos landfill appears to be captured on aerial photography (Section 3.1.1); however, the extent of the northern asbestos landfill is difficult to distinguish from aerial photography. The asbestos landfills were constructed as early as the late 1970s or early 1980s (CFAC, 2003). Disposal records for the northern asbestos landfill indicate that the landfill was in use from 1993 to 2009 (CFAC, 2009).

Details regarding landfill construction and presence of liners and caps are unknown.

3.2.2 Percolation Ponds

Water from Site operations and stormwater discharges to several percolation ponds. Details regarding the percolation ponds are provided in the sections below.

3.2.2.1 North Percolation Pond (East)

The North-East Percolation Pond is approximately 2.0 acres in size. The depth of the percolation pond is unknown.

The North-East Percolation Pond was constructed in 1955. The North-East Percolation Pond is currently operational and a discharge point for stormwater drainage. As described below, this percolation pond received discharges from various operations within the Main Plant area until manufacturing ceased in 2009. Based on the aerial photography review, the exact size and shape of the North-East Percolation Pond changed slightly over time.

The North-East pond received water from permitted outfalls (Outfall 007 and Outfall 008). The north percolation pond received discharges from the Anode Paste Plant Briquette System, non-contact cooling water, non-process wastewater from the masonry shop, battery shop, garage, garage steam clean and pin steam clean, boiler blowdown water from the lab, air conditioner condensate, Paste Plant Wet Scrubber Blowdown (until 1999), Carbon Cathode Soaking Pits (prior to 1978), and process area stormwater (2014 MPDES Permit Fact Sheet; E&E, 1988).

In 1994, the total daily average flow was 2.4 million gallons per day (MGD) and up to 2.5 MGD with stormwater (CFAC, 1994). The original (1982) draft MPDES permit application estimated daily flow at 2.0 MGD (CFAC, 1982). In 1982, the majority of flow was from bearing cooling water and carbon paste plant contact cooling water. According to the 1999 MPDES permit, the North-East percolation pond has been partially sealed by the settling of fine grain sediments (1999 MPDES permit). The total daily average flow of the two permitted outfalls during manufacturing operations based on the 2014 MPDES permit was 1.8 million MGD.

Surface water and sediment were sampled from the North-East percolation pond during the Site Reassessment. Surface water samples contained TAL metals concentrations in exceedance of SCDM benchmarks or Montana Aquatic Life Acute or Chronic ~~guidance values~~standards for aluminum, cyanide and zinc. For dissolved metals, aluminum and zinc exceeded Montana standards and/or USEPA ~~guidance values~~benchmarks. Sediment samples also contained SVOCs (predominantly PAHs) above USEPA SCDM ~~guidelines~~benchmarks.

3.2.2.2 North Percolation Pond (West)

The North-West Percolation Pond is approximately 8 acres in size (Figure 3). The North-West Percolation Pond receives water from the North-East percolation pond. The two ponds were connected by an approximately 1,440 foot long unlined ditch.

Based on the review of aerial photography, the North-West Percolation Pond appears to be in the process of being constructed in 1972. Historic flow rates into the North-West Percolation Pond should have been slightly less than North-East percolation pond (due to infiltration, storage and evaporation in the western pond).

No surface water samples were collected during the 2014 Site Reassessment. Sediment samples contained SVOCs (predominantly PAHs) above USEPA SCDM guidelines.

3.2.2.3 West Percolation Pond

The West Percolation Pond is approximately 0.05 acres in size, and is located just north of the main parking lot west of the main plant (Figure 3).

The West Percolation Pond was first observed on aerial photography from the 1980s. The West Percolation Pond received boiler blowdown from the Fabrication Shop, Warehouse and Change House and stormwater from the parking lots (2014 Draft MPDES permit fact sheet).

No sampling was conducted during the 2014 Site Reassessment Report.

3.2.2.4 South Percolation Ponds

The South Percolation Ponds are a series of three ponds located on the south end of the Site, adjacent to the Flathead River. The ponds are 2.4, 1.2 and 6.6 acres (from west to east) forming a total of 10.2 acres. The ponds are connected in series. Wastewater enters the South Percolation Pond system from a concrete pipe located on the ~~east~~ west end of the pond system. From the pipe, water flows into the ponds through an unlined ditch.

The South Percolation Ponds receive water from the sewage treatment plant, the aluminum casting contact chilling water, non-contact cooling water from the rectifier and other equipment, process wastewater from the casting mold cleaning and steam cleaning, non-process wastewater from the fabrication shop steam cleaning and stormwater (2014 Draft MPDES Permit Fact Sheet).

Surface water samples collected during the 2014 Site Reassessment contained TAL metals concentrations in exceedance of SCDM benchmarks or Montana Aquatic Life Acute or Chronic ~~guidance values~~standards for aluminum, cyanide, iron, lead, and zinc. For dissolved metals, aluminum~~, ~~ and copper, exceeded Montana Aquatic Life standards and/or USEPA SCDM chronic ~~guidance values~~benchmarks.

Sediment exceeded USEPA SCDMs for the following SVOCs: benzo(k)fluoranthene, benzaldehyde, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.

3.2.3 Main Plant Area

The Main Plant Area (Figure 3) includes the buildings used for production of aluminum and various support buildings, warehouses and storage areas. The Main Plant Area includes the following Site features:

- The pot line buildings where the aluminum smelting occurred;
- The casting house, mechanical shops, paste plant, Rod Mill, and warehouses adjacent to the pot lines;
- Raw material storage areas (petroleum coke, coal tar pitch, alumina, etc.);
- Fueling station at the plant;

- The rectifier yard;
- Various USTs, ASTs and dry wells; and
- Site drainage system.

Details of the Site features listed above are provided in the following sections.

3.2.3.1 Pot Line Buildings

The Main Plant Area is where the production of aluminum occurred. The facility is approximately 47 acres, and spans approximately 1,760 feet by 1,170 feet.

In 1955, the plant began operation with 4 pot rooms. The plant expanded to 10 pot rooms in the 1960s. The pot line buildings have courtyards and various support buildings in between the pot rooms (Plate 3). The courtyards contained air ventilation structures including the dry scrubbers. Support buildings include the casthouse, offices, garages, and a briquette storage area (Anaconda Aluminum, 1981).

The dry scrubbers in the plant were installed to replace a wet scrubber sludge system, which operated until final installation of the dry scrubbers in 1976 to 1978 timeframe. Prior to 1978, the cathode soaking pits were used to cool pots. Historical documents suggest these pits were located to the east of potline 4, at the northern end of the Main Plant Area potline buildings. The potential location of the cathode soaking pits is shown on Plate 3.

Many raw materials were required for aluminum production, and were stored on Site. Raw materials were delivered to the Site at several transfer stations, located just north of the Main Plant, and adjacent to the railroad. Raw material transfer stations include the Petroleum Coke Building, the Alumina Unloading Stations, and the Lime Unloader station (Anaconda Aluminum, 1989).

3.2.3.2 Site Drainage System

A series of catchbasins, sewers, dry wells, and sumps handle stormwater, process water, and non-contact cooling water at the Site (Plate 3). Drainage piping runs in between pot room buildings, and there is evidence of floor drains in several buildings. The sewers discharge at the percolation ponds, as described in Section 3.2.2.

3.2.3.3 USTs/ASTs

Several USTs and ASTs are present within the Main Plant Area, containing fuel oil, diesel, gasoline, soluble oil and used oil. Sumps for soluble oil and hydraulic oil were located in the area as well. Historically, several of the USTs contained transformer oil or served as transformer oil sumps. A full list of USTs/ASTs, their location, size, and contents is provided in Table 2.

Based on the documents reviewed, there were two historical leaks/spills, including: a diesel spill on 10/25/1989 and a UST leak on 1/19/1990. MDEQ was notified and the spills were investigated and remediated. MDEQ sent a letter stating no further action dated 9/7/1994. A closure letter for the 1989 diesel spill was not found in the available documents.

3.2.3.4 Rod Mill

The Rod Mill is approximately 1.2 acres and is located on the southwestern part of the Main Plant Area (Figure 3). The Rod Mill was used as a Rod Mill during the first decade of plant operation. Afterwards, the Rod Mill was used for storage. During the 1990s, the Rod Mill was used for storage of hazardous waste, including SPL and PCBs (RMT, 1997).

3.2.3.5 Paste Plant

The Paste Plant manufactured anode briquettes from petroleum coke and coal tar pitch. Once made, the briquettes were sent to the Main Plant Area for use in the pots. Several other buildings were part of the briquette making process, including the petroleum coke unloading building, a petroleum coke silo, a paste plant wet scrubber (replaced by a dry scrubber in 1999) and coal tar pitch tanks, and a coal tar pitch unloading shed (RMT, 1997, E&E, 1988, CFAC, 2003).

3.2.3.6 Rectifier Yards

Rectifier yards are to the south of the main plant, and are approximately 18 acres in size (Figure 3). The rectifier yard was essential to powering the Site operations. A portion of the rectifier yards are owned by Bonneville Power Administration.

Transformers and capacitors in the rectifier yard historically used transformer oil containing PCBs. Transformer oil containing PCBs were removed in the 1990s (RMT, 1997, pgs. 31-32).

Two leaks and spills have been documented in the west rectifier yard; one in 1991 and another in 1994. Both spills have been remediated and the areas cleared for use (CFAC, 1994).

3.2.3.7 Dry Wells

Several dry wells are also present within and around the Main Plant Area, and are regulated under the MPDES permit as outfalls 011 and 012. These outfalls receive boiler blowdown water from the Paste Plant and non-contact cooling water from the electromelt furnace, respectively (2014 Draft MPDES Permit Fact Sheet).

A review of historic plant drawings (dated May, 1981) showed 11 dry wells and the more recent SWPPP drawings (undated) showed 14 dry wells around the Main Plant Area. These dry wells are shown on Plate 3. In addition, a historical drawing from the 1950s indicates that Drywell 31 was the historical discharge point for chemical disposal sink within the Lab Building.

3.2.4 Operational Area Soils

The Operational Area Soils refer to areas of the Site not associated with any of the Site features discussed in previous sections but were part of historic Site operations. The Operational Area soils generally include the areas between the landfills and the Main Plant, the former drum storage area, and the areas around the Site railroads.

3.2.4.1 Aerial Disturbance and Equipment Storage

Based on a review of aerial photography (Section 3.1.1), soils surrounding the Main Plant, adjacent to the landfills, and in-between the main plant and the landfill were used for staging various equipment and materials throughout time. Patterns of ground disturbance (predominantly from truck traffic or material storage) were observed on aerial photography.

3.2.4.2 Railroads

Railroad tracks were present throughout the Site, and were integral to delivery of raw materials, shipping products, and disposal of wastes. Railroads are commonly associated with PAHs and metals in soil.

3.2.4.3 Former Drum Storage Area

As identified in Section 3.1.1, a 1980 CFAC hazardous waste permit identified a drum storage area that was used to store hazardous waste in the 1980s (Anaconda Aluminum, 1980). The former drum storage area was 250 foot by 200 foot and located west of the Wet Scrubber Sludge Pond. According to a 1986 internal correspondence from Ken Reick to Don Ryan, the drums were on a storage pad for secondary containment, however, there was no roof, so drums were exposed to precipitation (Ryan, 1986).

3.2.5 Site-Wide Groundwater

As discussed in Section 3.1.3, elevated levels of fluoride and cyanide are present in Site groundwater due to historic Site operations. Groundwater received landfill leachate, stormwater runoff, and recharge through the percolation ponds and dry wells throughout the Site's operational history. Based on the existing network of groundwater monitoring wells, groundwater with the highest concentrations of fluoride and cyanide are directly downgradient of the Wet Scrubber Sludge Pond and West Landfill.

3.2.6 Site Surface Water

As discussed in Section 3.1.4, there are three main surface water bodies on Site: Flathead River, Cedar Creek, and Cedar Creek Overflow Ditch.

3.2.6.1 Cedar Creek

Cedar Creek is fairly shallow, and based on elevation of the groundwater table, groundwater from the Site ~~does~~ may not recharge into Cedar Creek. A tributary to Cedar Creek flows, or has flown, historically east of the Industrial Landfill and to the southwest, joining Cedar Creek approximately ½ mile to the southwest of the landfill. A surface water sample was collected from Cedar Creek during the 2014 Site Reassessment. Cyanide was detected at 49 µg/L (estimated; biased low), above Montana Aquatic Life acute and chronic standards (22 µg/L and 5.2 µg/L, respectively). A background sample was also collected within Cedar Creek and was non-detect for cyanide.

3.2.6.2 Cedar Creek Overflow Ditch

The Cedar Creek Overflow Ditch runs from the Cedar Creek Reservoir to the Flathead River. The Cedar Creek Overflow Ditch runs alongside the Sanitary Landfill, Center Landfill, the southern Asbestos Landfill, and the East Landfill and Leachate Collection Ponds before discharging into the Flathead River.

Runoff from landfilling operations could have potentially impacted the overflow ditch. Groundwater near the Cedar Creek Overflow Ditch is at elevation 3,144.33 ft-amsl (at TW-9) and the elevation of the adjacent Cedar Creek Overflow Ditch is approximately 3,186 ft-amsl (Plate 1). Based on elevation, it is unlikely that the Cedar Creek Overflow Ditch receives groundwater. No surface water samples were collected during the 2014 Site Reassessment.

3.2.6.3 Flathead River

The Flathead River runs along the southern border of the Site, and as described in Section 2.5.1. Groundwater from the Site discharges to the Flathead River.

Due to the steep banks along the Flathead River, some of the Site groundwater discharges from the cliffs, and flows down to the Flathead River. This area has been previously referred to as "the Seep". The approximate extent of the Seep is shown in Figure 3. As described in Section 2.8.16~~5~~, the Seep water is tested quarterly ~~for acute aquatic toxicityusing WET testing~~ to assess for acute toxicity using the WET testing methods specified in ~~pursuant to~~ CFAC's 2014 MPDES permit. The Seep water has passed the WET test each quarter, therefore indicating no acute toxicity under the conditions of these tests.

3.3 Conceptual Site Model

A preliminary CSM was developed for the Site based on the existing data. The CSM identifies areas of concern at the Site, describes the potential migration and exposure pathways for Site contaminants, and provides a preliminary assessment of human health and environmental impacts associated with the Site contaminants.

The preliminary CSM is used to summarize the current understanding of the Site and identify where data gaps exist. The CSM also facilitates the development of data quality objectives, which in turn are used identify locations where sampling and other data collection efforts are necessary during the remedial investigation. The preliminary CSM will be updated as a more detailed understanding of Site conditions is developed during the course of the RI and can be modified as additional data is collected. The CSM is summarized in Figure 10.

3.3.1 Sources of Contamination

Based on the results of previous sampling conducted at the Site and review of historical operational data, the potential sources of contamination include:

- Landfills (including the closed calcium fluoride sludge pond and closed leachate ponds);
- Percolation ponds;
- Plant drainage system including drywells and associated discharge points;
- Drum storage area;
- USTs and ASTs; and
- Waste and raw materials storage and handling areas.

Waste types and contaminants present in the landfills were reviewed in Section 2.7.2. While a wide variety of wastes were reportedly disposed in the landfills, the primary hazardous waste stream generated and disposed at the Site was SPL. The primary contaminants detected in groundwater downgradient of the landfills are associated with SPL leachate, including cyanide, fluoride, and various metals (including aluminum, sodium, nickel, chromium). VOCs, PCBs and pesticides were not detected in any groundwater samples and SVOCs were detected only at trace levels (typically less than 1 μg/L).

The current status of the various landfills (i.e., size, depth, operational/closed, lined/capped, etc.) is presented in Section 3.2.1. Importantly, the existing elevation data for the regional water table and surface grade around the landfills indicates that the bases of all Site landfills are located above the water table. This indicates that capping (which eliminates infiltration) can likely serve to environmentally isolate the waste materials contained in the landfills, which in turn should greatly reduce or eliminate the potential for future groundwater impacts. As described in Section 3.1.3, the groundwater quality improvements observed are consistent with the landfill capping projects undertaken in the 1980s and 1990s. Cyanide and fluoride concentrations have exhibited an overall decreasing trend from 1998 to 2014. While the overall trend is decreasing, the monitoring data also indicate short-term fluctuations that may be attributable to seasonal variations or the influence of precipitation events.

The waste streams discharged to the percolation ponds were reviewed in Section 3.2.1. The North Percolation Ponds contains contaminants such as nickel, chromium, beryllium, copper, zinc, soluble oils, coal tar, lube oil, aluminum, antimony alumina and carbon solids, soluble fluoride, battery acid, grease, and solvent residues. SVOCs, metals, and fluoride were detected in surface water samples collected from the North-East Percolation Pond during the Site Reassessment (Weston, 2014). No water was present in the North-West Percolation Pond to sample. SVOCs, pesticides, metals, and fluoride were detected in sediment samples collected from both North Percolation Ponds. The South Percolation Ponds contain contaminants such as soluble oils, chlorine, and treated sewage, alumina, soluble fluoride, hydraulic oil, benzo(a)pyrene, antimony, nickel, aluminum, and fluoride. Concentrations of SVOCs, metals, and fluoride were detected in surface water samples collected from the South Percolation Ponds. SVOCs, pesticides, metals, and fluoride were detected in sediment samples at concentrations above the reporting limits in waste sediments collected from the South Percolation Ponds.

Historical records and previous investigations indicate that no environmental data have been collected from areas surrounding USTs/ASTs, the drum storage areas, and other waste and raw materials storage and handling areas. Likewise, historical records and previous investigations indicate that no environmental data have been collected to assess potential contamination emanating from the Site drainage system, including drywells associated with the system. All of these areas will need to be investigated as part of the data gaps as described further in Section 4.1.

As discussed further in Section 5.0, further historical data review and additional Site reconnaissance will be conducted as part of the Phase 1 RI. The CSM will be updated if additional contaminant sources are identified during investigation activities.

3.3.2 Potential Exposure and Migration Pathways and Receptors

The following sections describe the primary migration and exposure pathways and discuss potential receptors that may be impacted by each pathway. As shown in Figure 10, migration pathways associated with the following media have been identified in the initial CSM as requiring evaluation, including:

- Groundwater;
- Surface water and sediments;
- Food chain;
- Soil vapor; and
- Soil.

Associated with each pathway are potential receptors and potential routes of exposure that have been identified based upon evaluation of current Site use and land use in the area of the Site. The CSM will be updated to address potential future Site uses during preparation of the Baseline Risk Assessment Work Plan.

A blue dot within Figure 10 indicates a potential exposure pathway that will require evaluation at the completion of the Phase 1 Site Characterization during preparation of the Baseline Risk Assessment Work Plan. As further described in Section 6.0, some of the potential exposure pathways may be determined to be incomplete and therefore not require evaluation in the risk assessment; while others will be retained for quantitative evaluation in the risk assessment.

The current understanding of each pathway is further described below.

3.3.2.1 Groundwater

Based on the data collected at the Site to date, groundwater is the primary migration pathway for contaminants of concern to potentially impact Site receptors. Releases to groundwater were previously documented during historic Site investigation activities, in the 2014 Site Reassessment Report (Weston, 2014) and as part of the MPDES data collection activities. The primary documented contaminants of concern in groundwater are fluoride and cyanide; however, further investigation and monitoring is necessary to determine to what extent other contaminants may be impacting groundwater quality at the Site.

Contaminants dissolved in groundwater will migrate in the direction of groundwater flow, which is generally in a southerly direction towards the Flathead River. Contaminant concentrations in groundwater, including cyanide and fluoride, decrease with increasing distance downgradient of the source areas due to natural attenuation processes, including, sorption, degradation and dilution/dispersion. The Flathead River and its associated biota are potential receptors for impacted groundwater. Ultimately, the majority of the groundwater beneath the Site is expected to discharge to the Flathead River adjacent to or at locations further downstream from the Site. As described in Section 3.1.3, groundwater seepage containing cyanide and fluoride has been documented along the banks of the Flathead River.

As described in Section 3.1.3, Cyanide and fluoride concentrations have exhibited an overall decreasing trend from 1998 to 2014. While the overall trend is decreasing, the monitoring data also indicate short-term fluctuations that may be attributable to seasonal variations or the influence of precipitation events.

The depth to groundwater within the Main Plant Area and areas to the north ranges from approximately 70 feet below land surface (ft-bls) to 129 ft-bls based on the groundwater elevation data collected during 2013 Site investigation activities. In the vicinity of the Flathead River, the depth to groundwater is typically less than 20 ft-bls. Based upon the depth to groundwater and current Site use, there is limited potential for exposure of humans and/or biota to groundwater at the Site.

Groundwater is used as the primary source of drinking water for the residential community referred to as Aluminum City located immediately west of the Site. Groundwater is also used in the City of Columbia Falls, which is located further west of the Site. Therefore, the people who regularly obtain their drinking water from wells that are located in the vicinity of the Site are potential receptors in the event that groundwater contamination migrates offsite into these areas. According to the Site Reassessment Report (Weston, 2014), a query of the Montana Bureau of Mines and Geology (MBMG) Montana Groundwater Information Center database indicated that 533 wells were reported within a roughly four-mile radius of the Site within Flathead County (Department of Natural Resources and Conservation [DNRC], 2013). Of the 533 wells, depth to water was ranged between 12 to 620 ft-bls with an average depth to water of approximately 164 ft-bls (DNRC, 2013). The data collected during the two most recent residential well sampling rounds indicates that impacted groundwater has not migrated beneath the residential areas.

3.3.2.2 Surface Water and Sediments

Surface water features, comprised of Cedar Creek, the Cedar Creek Reservoir overflow drainage and Flathead River, are located along the western, eastern and southern borders of the Site, respectively.

The flat topography that exists within one-half mile of Cedar Creek, suggests there is little potential for overland transport of Site-related contaminants into Cedar Creek. In addition, the elevation of Cedar Creek is higher than groundwater elevations within the Site, indicating that Cedar Creek may ~~is~~ not be a potential discharge point for groundwater. Based on the 2013 sampling activities, cyanide was detected in the Cedar Creek sample at concentrations exceeding the SCDM benchmarks and MDEQ Aquatic Life ~~screening benchmarks~~standards. As this condition is inconsistent with the initial CSM, the RI will include sampling within Cedar Creek to determine if this condition persists, and if so, follow-up actions to identify the potential source will be conducted.

The Cedar Creek Reservoir Overflow Drainage flows intermittently in the spring and regulates flow for Cedar Creek and the Cedar Creek Reservoir. Based upon proximity and land surface topography, some surface water runoff from the eastern side of the Site (Center Landfill, Sanitary Landfill, and East Landfill) flows to the Cedar Creek Reservoir Overflow Drainage. The potential for erosion and overland transport of sediment from these areas into drainage has not been investigated.

The Flathead River is the most important surface water feature at the Site. Groundwater seepage and the migration of contaminants from South Percolation Ponds (located adjacent to the Flathead River within the 100 year flood plain) could potentially impact surface water, sediment, sediment porewater and biota within the Flathead River.

The "Seep" area (described in Section 3.2.6) is a documented groundwater discharge point within a backwater area of the Flathead River that has been monitored extensively in compliance with MPDES permit requirements. Historical monitoring has indicated the following:

- The concentrations of cyanide and fluoride measured immediately adjacent to the Seep (Monitoring location RIV-2) have declined overtime, consistent with the trends and for the same reasons as previously described for groundwater.
- The concentrations decrease immediately upon mixing within the surface water in Flathead River. Cyanide and fluoride consistently have not been detected at downstream monitoring locations over the history of the monitoring program.
- Samples of the Seep have been submitted for Whole Effluent Toxicity (WET) testing with all results indicating no observed toxicity to organisms exposed to 100% Seep water.

The primary receptor potentially influenced by surface water, sediment, and sediment porewater contamination is the biota present in and around the river. As described in Section 2.6, a search of the FWP, available online at http://fwp.mt.gov, indicates a variety of fish species were present in the Flathead River as of February 2015. Streamside wetlands along the Flathead River provide potential habitat at and downstream of the Site. The dominant vegetation is riparian lotic forested, intermixed with freshwater palustrine scrub-shrub and riparian lotic emergent wetlands, and pockets of riparian lotic scrub-shrub and freshwater palustrine emergent wetlands. These wetland types are also found onsite in the areas surrounding the South Percolation Ponds at the southern end of the site and adjacent to the Flathead River.

3.3.2.3 Food Chain

As documented in Section 2.6, the Site, including the Flathead River and Cedar Creek, provides a habitat for a diverse biological community. The Flathead River is used by Site visitors for recreational fishing within the Site study area. In addition, land owned by CFAC has been used by Site visitors and potentially by Site trespassers for recreational hunting and fishing (i.e. Cedar Creek). Cedar Creek may also be used for recreational fishing downstream of the Site. Therefore, the food chain pathway will require further evaluation.

3.3.2.4 Soil Vapor

As documented in Section 2.8.14, VOCs have only been detected at low concentrations in groundwater at the Site (maximum concentration of 6.2 µg/L) and only at two monitoring well sampling locations. As a result, there currently appears to be low potential for soil vapor concern at the Site. However, because widespread sampling for VOCs in soil and groundwater has not been conducted, the soil vapor pathway has been retained for further evaluation. The CSM identifies soil vapor as a potential exposure pathway for Site workers, and biota via inhalation route of exposure.

3.3.2.5 Soil

Soil conditions across the Site have not been the subject of investigation. The soil samples collected have been from known source areas (e.g., percolation pond soil samples during the 2014 Site reassessment) and post excavation samples following a few specific remedial actions described in Section 2.8 (i.e., following PCB cleanup, diesel spill investigation). As described in Section 3.2.4, Site-wide soils have been identified as a Site feature for investigation based upon transport of wastes throughout portion of the Site north of the Main Plant Area, material and equipment storage areas observed on aerial photography, various material loading/unloading areas, railroad operations, and drum storage areas. Soils across these areas could potentially be impacted with similar COPCs as groundwater and surface water.

The CSM identifies that such impacted soil as a potential exposure pathway for Site workers and biota via the direct contact, ingestion and inhalation routes of exposure. In addition to Site workers and Site biota, there is limited potential for unauthorized access by humans to the Site.

The Site is only accessible through private property and is partially fenced. An access gate is located north of the parking lot and restricts vehicular access.

3.3.2.6 Air

No complete pathways for ambient air were developed based upon the absence of any emission producing activities at the Site and the absence of VOCs in soil, sediment, groundwater and surface water samples collected to date. The potential for inhalation of windblown soil particulates will be evaluated via the inhalation route of exposure within the soil pathway.

The closest permanent residents to the Site are located in the residential community referred to as Aluminum City, which is greater than 0.35 miles southwest from any source area at the Site. However, there are no schools, daycare centers, or regularly occupied residences within this distance. The prevailing wind direction is from the south-southwest. Therefore, there is limited potential for soil/air impacts, if any, to migrate off-site and have an adverse effect on public health.

3.4 Preliminary Identification of Remedial Action Alternatives

Roux Associates has identified preliminary potential remedial action alternatives based upon an evaluation of existing data and the current understanding of Site conditions as summarized in the preceding sections. The purpose of identifying preliminary potential alternatives in the RI Work Plan is to ensure that data needed to support an evaluation of these alternatives are collected during the RI. A detailed evaluation of alternatives will be developed during the FS. In addition to those technologies and response actions described below, deed restrictions and institutional controls would be considered in conjunction with the listed remedial alternatives.

3.4.1 Landfills, Percolation Ponds and Soil Remedial Alternatives

Based upon our current understanding of Site conditions and review of the available analytical data, remedial alternatives which may be suitable for landfills, percolation ponds and other areas of impacted soil include:

- No action;
- Containment;

- *In situ* treatment;
- Excavation and off-site disposal; and
- Excavation/on-site treatment/on-site or off-site disposal.

These preliminarily identified alternatives represent a range of response actions including containment and treatment, consistent with USEPA guidance documents, and are similar for landfills, percolation ponds and Site-wide soils. However, the remedial approaches ultimately retained for detailed evaluation for individual Site features will likely vary, as certain potential remedies may apply to some but not all features described above.

3.4.1.1 No Action

The no action alternative will be evaluated to provide a comparative basis for other remedial alternative evaluations. The no action alternative may include only long-term groundwater monitoring currently being conducted and maintenance of existing engineering controls (e.g., existing landfill cap).

3.4.1.2 Containment

Containment alternatives that may be considered include:

- Caps or other impermeable barriers to isolate the contaminated soil/sludge/waste from contact with precipitation and groundwater; and
- Diversion of groundwater (e.g., pumping) to prevent contact with contaminated soil.

3.4.1.3 *In Situ* Treatment

In situ treatment is preliminarily identified as a remedial action alternative for contaminated soils because some of these soils may not be removable via excavation due to either proximity to structures or the depth of the contamination, without jeopardizing the integrity of overlying structures. Specifically, soil stabilization, bioremediation, phytoremediation, and soil vapor extraction (if VOCs are determined to be present) may be considered as potential remedial action alternatives.

3.4.1.4 Excavation and Off-Site Disposal

Excavation and off-site disposal is preliminarily identified as a remedial action alternative for organics and metals impacted soils at the Site. Evaluation of this alternative will consider permanence of remedy, need for treatment (e.g., solidification, stabilization) and classification of waste soils (hazardous or non-hazardous).

3.4.1.5 Excavation/Treatment and On-Site or Off-Site Disposal

Excavation and on-site treatment is preliminarily identified as a remedial action alternative for organics and metals impacted soils at the Site. Evaluation of this alternative will consider treatment techniques which reduce the toxicity and mobility of the excavated waste materials. Depending upon the degree of treatment, the final disposition of the material may be onsite or offsite.

3.4.2 Groundwater Remedial Alternatives

Groundwater quality conditions which will influence remedial alternative selection are discussed in Section 3.1.3. As discussed in Section 3.1.3, groundwater contaminated with COPCs (i.e., cyanide and fluoride) has been identified at the Site. Based on this information, tentatively identified groundwater remedial action alternatives include:

- No action;~~ and~~
- Groundwater extraction/treatment/disposal; and
- In-situ treatment.

3.4.2.1 No Action

The no-action alternative means that no groundwater extraction and treatment will be performed. This may include long-term groundwater monitoring currently being conducted.

3.4.2.2 Groundwater Extraction/Treatment/Disposal

Groundwater in the overburden can be pumped and treated either onsite or offsite. Depending upon the COPCs determined to be present, groundwater treatment alternatives may include air stripping (volatile organics), carbon adsorption (organics), chemical oxidation (organics), aerobic biodegradation (organics), chemical precipitation (metals), ion exchange (metals) or a combination of the above. Options preliminarily identified for disposal of treated groundwater include discharge to the sanitary sewer system which serves the Site, and reinjection.

3.4.2.3 *In Situ* Treatment of Groundwater

Groundwater in the overburden can be treated *in situ* to facilitate the attenuation or degradation of dissolved COPCs in groundwater. Treatment of dissolved contaminants *in situ* requires an assessment of groundwater flow, COPC concentrations, and Site geochemistry in order to develop a treatment method to break down the contaminants or reduce contaminant mobility. Depending on the COPCs present, options for *in situ* treatment may include reactive barrier to attenuate the movement of COPCs in groundwater and/or injection of chemicals or other amendments to stabilize or enhance degradation of dissolved COPCs.

3.5 Data Needs for Evaluation of Remedial Alternatives

Data regarding the physical characteristics of the Site and the physical and chemical characteristics of the impacted media (i.e., soil and groundwater) are required to evaluate the preliminarily identified remedial alternatives. The specific data needs and data gaps identified based upon an evaluation of previous investigations were considered during development of the Draft RI/FS Work Plan Rationale (Section 4.0) and Phase I Site Characterization Program (Section 5.0).

3.6 Applicable or Relevant and Appropriate Requirements

This section provides the preliminary identification of potentially applicable or relevant and appropriate requirements (ARARs) and any other guidance and criteria "to be considered" (TBC) for the Site. The preliminary identification of potential ARARs and TBCs will continue throughout the RI/FS process as more information is developed. In addition to the ARARs and TBCs described below, the work described in this RI/FS Work Plan will be completed in general accordance with the National Contingency Plan (40 CFR Part 300).

ARARs and TBCs are divided into three categories: chemical-specific, action-specific and location specific standards as described below.

- *Chemical-Specific ARARs* are typically health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, are expressed as numerical values. The values represent cleanup standards (i.e., the acceptable concentration of a chemical at the site).

- *Action-Specific ARARs* are generally technology- or activity-based requirements or limitations on actions or conditions taken with respect to hazardous substances on the Site. Action-specific ARARs do not typically determine the remedial alternative; however, the ARARs indicate how a selected alternative must be implemented or achieved.

- *Location-Specific ARARs* are restrictions on the concentrations of hazardous substances or the conduct of activities in special locations.

Potential chemical-specific and location-specific ARARs and TBCs were identified based on review of Site data. Potential action-specific ARARs and TBCs will be based on the remedial action alternatives to be developed in the FS. The USEPA will provide a more detailed list of action-specific ARARs and TBCs, which will be presented in the Feasibility Study, once remedial alternatives are identified.~~A more detailed list of action-specific ARARs and TBCs will be presented in the FS, once remedial alternatives are identified.~~

3.6.1 Chemical-Specific ARARs and TBCs

The following chemical-specific ARARs may be used to evaluate data during the RI/FS:

1. The Federal Safe Drinking Water Act (SDWA), 42 United States Code (USC) 300(g-1), 40 Code of Federal Regulations (CFR) 141.161. The SDWA sets MCLGs and MCLs for public drinking water supplies.

2. The Clean Water Act (CWA), 33 U.S.C 1311-1387 establishes the water quality criteria for surface water. The water quality criteria are designed to protect aquatic life (marine and freshwater) and human health. These criteria are expressed on the basis of acute and chronic toxicity levels. The selected remedy must comply with these criteria.

3. The Montana Department of Environmental Quality Circular DEQ-7 (DEQ-7) contains numeric water quality standards for Montana's surface and ground waters in accordance with ARM 17.30.620 through 17.30.670. The standards were developed in compliance with Section 75-5-301, Montana Code Annotated (MCA) of the Montana Water Quality Act, Section 80-15-201, MCA (Montana Agricultural Chemical Groundwater Protection Act), and Section 303(c) of the Federal Clean Water Act (CWA).

4. ARM 17.30.1005 and –1006 provide that groundwater is classified I through IV based on its beneficial uses and set the standards for the different classes of groundwater. All beneficial uses of groundwater must be protected. In addition to the Circular DEQ-7 Numeric Water Quality Standards listed above, concentrations of other dissolved or

suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to beneficial uses.

~~3.~~5. ARM 17.30.608 provides that the waters of the Flathead River are classified as B-1 for water use. The B-3 classification standards are contained in ARM 17.30.623 (applicable) of the Montana water quality regulations. This section provides the water quality standards that must be met and beneficial uses for the water use classifications, which must be protected.

Preliminary TBCs for the Site include:

1. Tables developed by the USEPA entitled "Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA, 2015) represent a preliminary TBC that may be applicable to a remedial action at the Site. These tables provide risk-based screening levels, calculated using default exposure assumptions, physical and chemical properties, and the most recent toxicity values. The EPA RSL soil criteria have been identified as potential TBCs for direct contact and leaching to groundwater-based soil screening levels (SSLs). The RSLs also provide criteria for indoor air concentrations for residential and industrial Sites, which can be applied as a conservative screening value for evaluating soil vapor results. For groundwater and surface water, the EPA RSLs contain requirements for tapwater to be used for compounds or chemicals with no DEQ-7 standard, MCL, or risk-based screening levels.

~~1.~~2. USEPA Office of Solid Waste and Emergency Response (OSWER) "Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air" (USEPA, June 2015) and USEPA Vapor Intrusion Screening Level Calculator (USEPA, June 2015). These tools can be applied to identify whether volatile hazardous chemicals that can pose a threat through vapor intrusion are present at the Site and to develop screening levels to compare subsurface soil vapor data.

~~2.~~3. Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases has been identified as a preliminary TBC for compounds in groundwater and surface water with no DEQ-7 standards or MCLs, and for soil with petroleum related compounds.

~~3.~~4. EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks are TBCs for sediment.

3.6.2 Action-Specific ARARs and TBCs

Action specific ARARs and TBCs are technology or activity specific requirements or limitations. The action-specific ARARs and TBCs will be used to screen remedial alternatives.

The following action-specific ARARs are applicable to the development of alternatives at Superfund sites. Additional ARARs will be generated as necessary during the RI/FS process.

1. RCRA Subtitle C regarding managing hazardous waste. Subtitle C contains regulations for generation; transportation, treatment, and storage and disposal of hazardous wastes. RCRA Subtitle C also includes air emissions from hazardous waste treatment, storage and disposal facilities are regulated under 40 CFR §261.

2. Clean Water Act 40 CFR 402, 405-471; 40 CFR 125; AAC Section 18-9-A901 establishes the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES permit program and state equivalent programs regulate discharges into "waters of the United States" by establishing numeric limits and monitoring requirements for such discharges.

3. Clean Air Act Section 111(b) describes emission guidelines for non-methane gasses generated from landfills (typically MSWLFs).

4. Montana Pollutant Discharge Elimination System (MPDES) program and ARM 17.24.633 contain provisions to control sediment and storm water ~~point source discharges of wastewater~~ such that water quality in state surface water is protected.

5. Safe Drinking Water Act (SDWA) Section 1422 describes the underground injection control (UIC) program for subsurface injection into groundwater. The UIC Program is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal, and therefore UIC Program regulations would be a potential ARAR for any such activities.

6. ARM 17.8.304, 17.8.308, 17.8.220, and 17.8.223 include requirements to address emission of particulate matter and dust control that must be complied with during remedial actions.

7. ARM 17.8.604 lists certain wastes that may not be disposed of by open burning.

8. Montana Solid Waste Management Act and regulations, §§ 75-10-201, *et seq.*, MCA, ARM 17.50.101 *et seq.* Regulations promulgated under the Solid Waste Management Act, § 75-10-201, *et seq.*, MCA, and pursuant to the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 *et seq.* (RCRA Subtitle D) specify requirements that apply to the to the transportation of solid wastes and the operation, closure and post-closure care of solid waste facilities.

~~5.~~9. ARM 17.74.369 specifies requirements for the management, transportation, and disposal of asbestos.

No action-specific TBCs have been identified.

3.6.3 Location-Specific ARARs and TBCs

Potential location-specific ARARs are identified and discussed in this section. Potential location-specific ARARs and TBCs address: cultural resources, wetlands protection, floodplain management, hydrological resources, biological resources, other natural resources, and geological characteristics.

The following location-specific ARARs are applicable to the development of alternatives at the Site. Additional ARARs will be generated as necessary during the RI/FS process.

1. The Endangered Species Act (16 USC. 1531-1544; 50 CFR Part 200 and 50 CFR Part 402) protects critical habitats upon which endangered species or threatened species depend. These regulations require action to conserve endangered species or threatened species, including consultation with the Department of Interior and the Fish and Wildlife Service.

2. National Historical Preservation Act of 1996, as amended (16 USC §§ 470-470x-6, 36 CFR pt. 800, 40 CFR§ 6.301[b], and the Archaeological and Historical Preservation Act (16 USC § 469-469c-1, 40 CFR § 6.301[c]).

3. Floodplain Management 40 CFR 6.302(b) Executive Order 11988 requires that federal agencies proposing actions to be located in a floodplain must first evaluate the potential adverse effects those actions might have on the natural and beneficial values served by the floodplain.

4. Protection of Wetlands 40 CFR 6.302(a) Executive Order 11900 directs federal agencies to avoid construction located in wetlands.

5. Montana Controlled Groundwater Areas pursuant to MCA 85-2-501 et Seq. to designate a controlled ground water area to prevent new appropriations or limit certain types of water appropriations due to water availability or water quality problems for the protection of existing water rights.

6. Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 *et seq.*, MCA, specify requirements that apply to the location of any solid waste management facility.

~~5.~~7. The Floodplain and Floodway Management Act, §§ 76-5-101, *et seq.*, MCA, and associated regulations specify requirements for activities in the floodplain or floodway.

No location-specific TBCs have been identified.

4.0 RI/FS WORK PLAN RATIONALE

The RI/FS Site Characterization Scope of Work was developed in a manner consistent with USEPA's "Guidance on Systematic Planning Using the Data Quality Objective Process (USEPA, 2006). The data quality objective (DQO) process is designed to clarify the objectives of data collection and maximize efficiency during data collection. It consists of a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in the decision making process are appropriate for its intended application. The following steps were completed as part of the DQO process in accordance with the USEPA guidance:

1. Define the problem
2. Identify the Goals / Decisions of the Study
3. Identify Information Inputs
4. Define the Study Boundaries
5. Develop the Analytical Approach
6. Specify Performance or Acceptance Criteria
7. Develop the Plan for Obtaining Data

A summary of the step-by-step DQO process followed to develop the scope of work for the Phase I Site Characterization is provided in the Quality Assurance Protection Plan (QAPP), which is included as part of the Sampling and Analysis Plan (SAP). The remainder of this section describes the specific types of information (data) needed to achieve the overall goals and objectives of the RI/FS; and the phased Site Characterization approach that will be followed to obtain the data.

4.1 RI Data Needs

The RI/FS Site characterization will need to generate data of sufficient quantity and quality to achieve the following objectives:

- Identify and characterize sources of contaminants of potential concern (COPCs);
- Determine the nature and extent of Site-related COPCs in soil, groundwater and surface water;
- Understand the transport and fate of COPCs in environmental media at the Site;

- Identify any complete or potentially complete exposure pathways (considering current and also potential future land use), evaluate current and future human health and ecological risks posed by the COPCs present at the Site, and complete a risk assessment in accordance with EPA guidance; and

- Support the development and evaluation of remedial alternatives for the Site.

The data needs are described with respect to source area characterization, hydrogeology, soil, groundwater, surface water, and sediment/sediment porewater.

Source Area Identification and Characterization

As identified in the CSM, various types of potential source areas exist at the Site. The following Site features have been documented as potential source areas at the Site.

- Landfills;
- Percolation ponds;
- Plant drainage system including drywells and associated discharge points;
- Drum storage area;
- USTs and ASTs; and
- Waste and raw materials storage and handling areas.

The data needs specific to landfills include:

- Identification of surface anomalies (if any) in the landfill caps, such as visual indication of surface contamination (e.g., seeps, stains, waste), erosional areas or stressed vegetation;

- Types and concentrations of COPCs (if any) in surface soils (if warranted based upon identified surface anomalies and field reconnaissance observations);

- Topographic survey to document erosional features, anomalies related to differential settlement (if any) within the landfill, and adequate slope for drainage;

- Determination/confirmation of existing cap construction (capping materials, cap extent and cap thickness) for each landfill feature (except East Landfill which has engineering records of construction);

- Determination of soil gas characteristics (potential for methane generation and assessment for VOCs in soil gas);

- Existing cap physical characteristics, including vertical permeability, plasticity, and/or others; and

- Additional groundwater monitoring data between and around landfill features to identify/confirm which COPCs are impacting groundwater; determine which landfills or portions of landfills are continuing sources of COPCs; provide vertical delineation of COPCs in groundwater immediately downgradient of the landfills.

<u>The data needs specific to the percolation ponds include</u>:

- Characterization of types and concentrations of COPCs in the soil / sediment within the influent ditches to North and South Percolation Ponds;

- Horizontal and vertical delineation of types and concentrations of COPCs in soil beneath the percolation ponds;

- Characterization of soil quality immediately outside the ponds to confirm impacts do not extend outside of the ponds; and

- Additional groundwater monitoring data upgradient and downgradient of percolation pond features to identify/confirm which COPCs are impacting groundwater; determine which ponds are continuing sources of COPCs; provide vertical delineation of COPCs in groundwater immediately downgradient of the ponds.

The plant drainage system, drum storage area, USTs/ASTs and materials storage and handling areas have not been subject to previous investigations. As such, the initial data requirements are to assess whether COPCs have been released at these locations and, if so, to determine the nature and extent of contamination associated with these areas.

<u>Hydrogeology</u>

Additional data are needed to refine the understanding of the hydrogeologic conditions beneath the Site that could potentially influence groundwater flow and contaminant transport. The following data are required to refine the hydrogeologic CSM:

- Depths, thickness and extent of water bearing units and aquifers across the Site;

- Depths, thickness and extent of potential confining units across the Site;

- Hydraulic properties (hydraulic conductivity, transmissivity, effective porosity) of water bearing units, aquifers and confining units;

- Depth to water table and thickness of vadose zone, and identification of perched water zones (if any) that could influence contaminant migration; and

- Water table and groundwater potentiometric surface elevations (to define hydraulic gradients, both horizontal and vertical) on a seasonal basis within the various water bearing units and aquifers.

The above data will allow for more detailed assessment of groundwater flow directions, and estimation of volumes and rates of groundwater movement through the various water bearing units and aquifers beneath the Site.

Soil Quality

Limited soil quality data has been collected at the Site during past investigations. The following additional data should be collected:

- Surface and shallow soil samples to evaluate the potential direct exposure pathway to humans and biota;
- Soil samples around Site Features and in the vicinity of receptors to further delineate soil quality horizontally and vertically; ~~and~~
- Soil samples in areas previously uninvestigated to determine the concentrations of COPCs, if any; and
- Soil samples to evaluate fate and transport processes.

Groundwater Quality

The current understanding of groundwater quality beneath the Site has been developed through sampling of the existing monitoring well network. The following additional data are required to supplement the existing data:

- Horizontal and vertical delineation of COPCs in groundwater within the various hydrogeologic units / aquifers beneath the Site;
- Characterization of seasonal variation in groundwater quality;
- Characterize speciation of various COPCs as necessary to evaluate mobility and potential toxicity (e.g., total cyanide vs free cyanide); and
- Develop geochemical data necessary to evaluate fate and transport of COPCs in groundwater.

Surface Water and Sediments

The Site reassessment report by Weston (2014) identified potential locations of groundwater entry to the river; however, additional data should be collected within Site features to verify the data collected during the Site reassessment. The following data should be collected:

- Confirmation of the horizontal extent of the groundwater seep to the Flathead River thru field inspection and sampling;
- Determine nature and extent of site-related COPCs in surface water, sediment, and sediment porewater within the Flathead River adjacent to the Site, within wetland area adjacent to Flathead River, and within Site drainage features (i.e., Cedar Creek and Cedar Creek Drainage Overflow) to further evaluate potential loading of contaminants of concern to receptors;
- Characterize surface water and sediment quality within the percolation ponds and other identified Site features (if standing water is present) to further understand source area data and refine the CSM; and
- Sampling should be conducted to evaluate seasonal influences and potential loading to surface water features during wet vs dry seasons.

Physical sampling and analytical methods were selected that would be appropriate for obtaining the necessary information inputs. A summary of the data collection methods are described in the sampling and analysis plan (SAP) and QAPP.

4.2 RI Approach

The RI/FS Site Characterization Program will be implemented in a phased approach, anticipated to consist of at least two phases of field work. The Phase 1 Site Characterization will focus on identification and characterization of source areas, and providing broad characterization of conditions across the Site (including at downgradient areas near potential human and ecological receptors).

The Phase 1 Site Characterization results will provide substantial data to refine the understanding of hydrogeologic conditions at the Site. This will be analyzed thru interpretation of the geophysical survey results, geologic logs of borings and water levels measured in wells and surface water. This will enable initial refinement of potential migration pathways for COPCs via the groundwater migration pathway, and enable assessment of the need for additional monitoring points in Phase 2 Site Characterization. In addition, the Phase 1 Site Characterization results will be evaluated to determine appropriate type, number and locations of aquifer slug tests to be conducted in the Phase 2 Site Characterization.

The Phase 1 Site Characterization results will also provide substantial data regarding soil, groundwater, surface water, and sediment quality at known and potential source areas. The sampling in these areas will generally be biased toward areas where contamination is suspected (if applicable) based upon the Site evaluation, field reconnaissance observations and field screening results (e.g., soil gas surveys).

The analytical results will be analyzed by comparison to the chemical-specific ARARs identified in Section 3.6. Analytical data from this sampling will be summarized and tabulated as part of the Phase 1 Site Characterization Summary Report. Data statistics for each media and significant Site features will be provided within the report, quantity of samples collected, the minimum, maximum, and mean concentrations, and frequency of detection.

RI Areas or Site features where analytical results are non-detect or where all analytes are well below ARARs will likely not require further evaluation as part of the RI/FS. Likewise, the Phase 1 Site Characterization results will be used to narrow the list of analytes for inclusion as COPCs in subsequent sampling and quantitative evaluation in the Baseline Risk Assessment. It is anticipated that the analytes identified as COPCs for further evaluation will vary between different Site features as well as between different environmental media across Site.

The results of the Phase 1 Site Characterization will be used to update the CSM and prepare the Risk Assessment Work Plan. During preparation of the Risk Assessment Work Plan, any outstanding data that still needs to be collected in order to complete the RI Site characterization and conduct a risk assessment will be identified. The identified data needs and the scope of work to collect the data will be presented in the Phase 2 Site Characterization SAP. In addition, the Phase II Site Characterization SAP will address specific data needs mentioned in Section 4.1 above, that are not being addressed during the Phase 1 Site Characterization program including:

- Topographic survey of the landfills;
- Investigation of the physical landfill caps, where present;

- Evaluation of the hydraulic properties of the various hydrogeologic units at the Site via slug testing; and
- Sediment porewater Sampling;

At the conclusion of the Phase 2 Site Characterization program, or any subsequent phases of Site characterization determined to be necessary, the risk assessment will be completed in accordance with the procedures outlined in Section 6.0.

4.3 Operable Units / Interim Actions

The NCP specifies that Sites should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of total site cleanup. In addition, where operable units are defined or interim actions are taken, it is required that they not be inconsistent with or preclude implementation of the expected final remedy.

The potential opportunity for defining operable units or using interim actions within additional RI Areas to accelerate remedial progress and risk reduction will be considered during the course of the Phase 1 Site Characterization Program and at its completion. As such opportunities are identified they will be evaluated. If a viable interim action appears to exist that meets the NCP criteria, a plan for such action will prepared and submitted for regulatory approval.

For example, as described in Section 5.3.4, there is potential for waste materials related to former operations to be encountered at the surface in some portions of the Site. Removal of the potential waste materials may be a candidate for an interim remedial action.

5.0 PHASE I SITE CHARACTERIZATION PROGRAM

The Phase I Site Characterization program has been designed to identify and/or confirm source areas and associated COPCs, as well as provide a broad characterization of the hydrogeologic conditions and the nature and extent of contamination across the Site. Based on the current understanding of the Site conditions and CSM, the following objectives were established for Phase I Site Characterization Program:

- Evaluate current conditions at all identified RI areas and Site features to determine which RI areas and Site features require further investigation and/or quantitative evaluation in the Baseline Risk Assessment;
- Refine the list of COPCs that require further investigation at various RI areas and Site features so lists of laboratory analyses can be reduced during subsequent phases of investigation;
- Refine the understanding of groundwater flow and groundwater quality beneath the Site, particularly in the vicinity of potential receptors;
- Develop a more detailed understanding of bedrock topography and the depths, thicknesses and extents of the various hydrogeologic units, both of which may influence groundwater flow and the distribution of COPCs in the subsurface;
- Begin to evaluate seasonal influences on groundwater/surface water interactions and contaminant concentrations in groundwater and surface water;
- Develop data to support the preparation of the Baseline Risk Assessment Work Plan; and
- Develop data to support identification and screening of remedial technologies as part of the FS.

To meet the objectives outlined above, the Phase I RI program will include additional historical data review, coordination of activities with the Site salvage/repurposing contractor (Calbag Resources, LLC), pre-intrusive Site reconnaissance work, source area investigation activities, and Site-wide soil, groundwater and surface water investigation activities.

The Scope of Work is described below and additional details regarding the Phase I field activities are provided in the SAP. Figures 11 through 16 provide a summary of the locations that will be investigated during Phase I field activities.

5.1 Additional Historical Records Review

Available historical records maintained by CFAC, including various historic environmental data, reports and correspondence, as well as various public records and databases; were searched compiled and reviewed to develop the understanding of Site conditions and initial CSM, and to facilitate scoping of this Draft RI/FS Work Plan. However, this process did not include a review of Site records maintained by USEPA and MDEQ to determine if they have information relevant to the RI/FS that was not contained within the records maintained by CFAC.

The review of the historical records will therefore continue during the Phase 1 Site Characterization Program. This will include submission of Freedom of Information Act (FOIA) requests to various governmental agencies, including the USEPA, MDEQ, and U.S. Army Corp of Engineers (USACE) for access to review any Site records they may maintain. In addition, the volumes of historical documents submitted by CFAC will continue to be reviewed to identify any additional information that could be relevant to the completion of the RI/FS. The findings from the additional records review will be evaluated to further the understanding of Site history and environmental conditions; and, when appropriate, to update CSM and identify additional areas for investigation.

5.2 Pre-Intrusive Investigation Activities

This section describes the activities that will be conducted prior to and in preparation for intrusive (i.e., drilling or test pitting) activities. The pre-intrusive activities will allow for a better understanding of Site conditions and a more accurate development of investigation Scope of Work.

5.2.1 Coordination of Activities with the Salvage/Repurposing Contractor

Calbag Resources, LLC (Calbag) was recently retained by CFAC to complete the decommissioning and removal of certain structures, machinery, equipment, and waste materials at the Site. Prior to beginning RI/FS field activities, planning meeting(s) will be conducted with Calbag to properly coordinate the Phase 1 Site Characterization program. The purpose of this planning will be to determine how best to sequence and/or adjust RI/FS work activities in the vicinity of the ongoing Site decommissioning activities, to meet the RI/FS and worker health and safety objectives.

5.2.2 Site Reconnaissance

Prior to conducting field investigation activities, an initial detailed Site reconnaissance will be performed to document the current conditions of the Site.

The objectives of the Site reconnaissance are to:

- Verify existing base maps and aerial photographs (check for accuracy of coordinates);
- Refine soil boring locations that are proposed to be biased towards areas of known or suspected areas of contamination;
- Identify any additional areas/Site features where COPCs were potentially released and where samples should be collected, based upon visual indications of waste materials, soil piles, staining, stressed vegetation, etc.;
- Develop a further understanding of drainage / overland flow and document any erosional features at the Site that may be contaminant migration pathways;
- Identify habitat areas for further evaluation in the Screening Level Ecological Risk Assessment (SLERA); and
- Confirm accessibility and determine equipment requirements for access to proposed sampling locations.

The Site reconnaissance will be conducted using a systematic approach. As a first step of the ground-level Site reconnaissance, a licensed land surveyor will establish coordinates of several fixed locations at the Site. The accuracy of the existing geo-referenced maps and aerial photographs will be evaluated by comparing coordinates obtained from GIS with the coordinates established by the surveyor. Likewise, the accuracy of hand-held GPS will be evaluated by comparing GPS coordinates with coordinates established by the surveyor. Any discrepancies in coordinates between the various locating methods will be resolved prior to proceeding with additional elements of the Site reconnaissance task. The subsequent ground level field reconnaissance will consist of qualified scientists or engineers visually inspecting and photo-documenting the conditions of all Site features within the various RI Areas as well as the overall conditions throughout the Site. The reconnaissance will also include inspection of building interiors, with the objective of identifying strategic locations for subsequent soil borings to assess soil quality conditions beneath the buildings. Field notes and photographs will be taken to document all significant observations. The locations of such observations will be established using handheld GPS. The locations of building interior observations will be noted on Site plans.

Key subcontractors (e.g., geophysical survey, drilling, etc.) will take part in the ground level field reconnaissance to confirm equipment requirements for accessibility and to confirm the technical approach for their respective assignments.

The Site reconnaissance will also include an inspection of existing Site monitoring wells to evaluate the integrity and accessibility for use during the investigation. Any deficiencies or obstructions will be noted for future consideration when planning sampling activities.

The Site reconnaissance will also include a habitat and biological survey. The Survey will include both terrestrial and aquatic habitats. The survey ~~and~~ will allow for determining the potential presence of species of concern at the Site and a detailed characterization of the environmental setting as it pertains to the SLERA. The survey will be conducted by a team of two biologists over a period of one to two weeks. It will include walking the entire Site, including visual inspection and photo-documentation of all distinct habitat areas and flora and fauna observed within these areas and recording of field notes regarding these observations.

5.2.3 Geophysical Survey

A geophysical survey will be completed as a screening tool to permit initial assessment of subsurface characteristics prior to drilling activities. The geophysical survey will employ electrical resistivity technology, with the goal of providing a preliminary understanding of approximate depth to bedrock, approximate depth to groundwater, approximate depth of Site features, potential changes in subsurface hydrogeological conditions, and potentially other subsurface anomalies that may contribute to the delineation of source areas.

It is anticipated that ground penetrating radar (GPR) can provide useful information to confirm the horizontal extent of landfills and associated landfill caps, as well as information on cap thickness. Therefore, GPR will be utilized as part of the landfill cap investigation. In addition, GPR will be utilized when appropriate for mark out of subsurface utilities or obstructions in the area of proposed drilling locations.

The actual methodology and scope of the geophysical survey will be finalized following the Site reconnaissance meetings with the selected geophysicist subcontractor, based upon an evaluation of the potential benefits towards achieving the RI objectives.

5.2.4 Soil Gas Survey

Prior to initiating drilling activities, a soil gas investigation will be conducted as a screening method within RI Areas and Site features where existing information suggests that VOCs could potentially be present.

The soil gas investigation will consist of two elements: 1) field screening of landfill soil gas; and 2) passive soil gas samples collected at the former hazardous waste drum storage area and the former vehicle fueling area. A description of the work associated with each element is described below.

5.2.4.1 Landfill Soil Gas Screening

Field screening of soil gas will be conducted at landfills to evaluate the potential for methane and VOCs. The screening will be conducted under falling barometric pressure conditions (minimum 12 hours) in order to minimize the potential for false negative results. Prior to the sampling, the barometric pressure will be confirmed using data from the NOAA National Climatic Data Center Station #244560 located approximately 6.5 miles southwest of the Site in Glacier Park International Airport.

At each location, a soil gas probe constructed of a 0.5 inch diameter stainless steel pipe with a welded and slotted tip on the end will be pushed into the subsurface to a depth of approximately ~~three~~ five feet. After advancing the probe to the final depth, the annular space around the probe will be sealed at the surface with modeling clay or equivalent to minimize potential short-circuiting of ambient air during sampling. A short length of Teflon tubing will be attached to the soil gas probe and a vacuum pump, and then the probe will be purged for five minutes to allow the inflow of vapors. The monitoring point will be tested using a tracer gas (helium), prior to sample collection, to verify that ambient air is not diluting the soil vapor during screening. A GEM 2000+ Landfill Meter will then be attached to the Teflon tubing and readings recorded for methane, carbon monoxide, hydrogen sulfide, oxygen, and barometric pressure. A photoionization detector (PID) will then be attached to screen for VOCs. Within the West Landfill where landfill gas vents are present, the screening will be conducted from the landfill vents.

5.2.4.2 Passive Soil Gas Investigation

A passive soil gas investigation will be conducted at the hazardous waste drum storage area and the former vehicle fueling area. The objective of the passive soil gas investigation is to identify potential hot spots (if any) so that subsequent intrusive sampling can be focused in these areas to determine if VOCs are a COPC. The passive soil gas investigation will be conducted using Amplified Geochemical Imaging, LLC (AGI) passive sampling devices. The AGI passive sampler is a proprietary, passive, sorbent-based sampler which collects volatile and semi-volatile compounds present in air, soil gas and water (AGI, 2015).

The AGI passive samplers will be installed within a 1/2 to 1-inch (2.5cm) diameter hole and to a depth of approximately ~~three feet (1 meter)~~five feet below grade; therefore resulting in minimal Site disruption and allowing for a screening of Site features. Following collection, the AGI passive samplers will be shipped to AGI for analysis of VOCs according to a modified USEPA 8260 analytical method, using gas chromatography (GC) and mass selective detection (MS).

The passive sampling is meant to provide an initial screening of vapor conditions. Subsequent soil borings will be biased towards the locations that exhibited the highest VOC concentrations. If the passive soil gas investigation results suggest that a source area may exist that extends beyond the investigated area, additional vapor sampling and intrusive activities would be considered to further evaluate the source area conditions.

5.2.5 SAP Addendum

Roux Associates anticipates that adjustments to the Phase I SAP will be required based upon the results of the pre-intrusive investigation activities described above. These adjustments may include modification or elimination of sampling locations or analyses, as well as the addition of sampling locations. Therefore, a SAP Addendum will be prepared to document the adjustments and their associated rationale.

5.2.6 Investigation Derived Waste (IDW) Plan

A plan for disposition of investigation derived waste (IDW) will be prepared in accordance with the USEPA Guide to Management of Investigation-Derived Wastes (USEPA, 1992). The options for handing IDW will consider the type and quality waste produced, its relative threat to human health and the environment, and other Site-specific conditions. The IDW Plan will be submitted to the USEPA as an addendum to the SAP prior to the start of the Phase I Site Characterization field work.

5.3 Source Area Investigation

The following section describes the investigation activities that will be completed within the vicinity of the Site features identified as potential source areas in the CSM.

5.3.1 Landfill Investigation

The objective of the landfill investigation is to 1) generate the information to determine if, and to what extent, the existing caps at the various landfills can serve as elements of the final remedy; and 2) to generate additional information required to evaluate remedial alternatives for the landfills. The landfill investigation will include the following elements during Phase I:

- GPR survey to assess uniformity of cap material and thickness across the landfill;
- GPR and test pitting to define extent and contents of asbestos landfills; and
- Installation of additional monitoring wells adjacent to each landfill to evaluate what extent the landfills (and which landfills in particular) are sources of COPCs in groundwater.

Data collection methods used for landfill investigation will need to ensure that landfill cap integrity is not compromised and/or include provisions for repair of any areas that are disturbed in order to complete the investigations. The details regarding each of the above elements are provided in the SAP.

5.3.2 Source Area Soil Boring and Soil Sampling Program

Following pre-intrusive screening activities, soil borings will be advanced to assess soil quality conditions at and in the vicinity of the Site features identified as potential source areas. The locations of the soil borings at potential source areas will be selected based on a judgmental sampling design that is biased toward areas where historical data and the results of the pre-intrusive investigation activities suggest COPCs may be present. Performing targeted investigations around the RI Areas will allow for verification of potential sources areas and COPCs and initial assessment of horizontal and vertical distribution of COPCs. The proposed sampling locations are further described in the SAP.

Soil borings will be completed utilizing sonic-rotary methods and/or direct push techniques. At all of the soil boring locations, continuous core samples will be collected from land surface to the bottom of the borehole in an effort to obtain lithologic and soil screening data. All of the soil samples will be described in accordance with the Unified Soil Classification System (USCS). The core samples will be examined for evidence of potential impacts (i.e., staining, odor) and screened for the potential presence of VOCs using a PID. The final depth of each soil boring will vary depending on the purpose and location of the boring. It is anticipated that all soil borings will be completed to a minimum depth of 12 ft-bls.

At soil borings locations where both water table and deeper monitoring wells are to be installed (described in Section 5.6.1 below), the soil boring for the deeper well will be drilled first. This boring will be advanced until one of the three following criteria are met 1) the top of bedrock is encountered; 2) a maximum depth of 300 feet below land surface is reached without encountering bedrock; or 3) a shallower depth, at the discretion of the field geologist in consultation with the management team, if a deep hydrogeologic unit is encountered beneath a significant sequence of low permeability material. While drilling deep soil borings, undisturbed core samples will be collected for geotechnical analysis within the major water bearing units and low permeability units including grain size, bulk density, and hydraulic conductivity. In addition, organic carbon will be analyzed at each soil interval sampled within the deep monitoring well locations to support the fate and transport analysis described in Section 5.7.

Three soil samples will typically be collected for laboratory analyses from each soil boring within unpaved areas: a surface soil sample will be collected from the top six inches of soil; a shallow soil sample from the interval of 0.5 to 2 ft-bls; and a deeper sample from a depth of 10 to 12 ft-bls. In paved areas, the surficial sample will be omitted (due to pavement) and shallow sample will be collected from the 2-ft depth interval immediately beneath the pavement materials and deeper sample will be collected from 10 to 12 ft-bls. If contamination is evident in the 10 to 12-foot-interval soil sample, drilling and sampling will proceed until contamination is no longer evident in the soil samples, until groundwater is encountered, or the limit of the equipment has been reached. A soil sample will also be collected from the five to ten feet below the water table at each deep monitoring well location. Additional soil samples may be collected and sent for laboratory analyses during soil boring activities, based on visual observations and/or soil screening results encountered during drilling activities.

Soil samples within the first 12 ft-bls will be analyzed for the following parameters:

- Target Compound List (TCL) VOCs (excluding surface soil samples) via USEPA Method 8260;
- TCL SVOCs via USEPA Method 8270;
- TAL Metals via USEPA Method 6010;
- TCL PCBs via USEPA Method 8082;
- TCL Pesticides (select surface samples only) via USEPA Method 8081;
- Total Cyanide via USEPA Method 9012; and
- Fluoride via USEPA method 300.

Soil samples collected from the five to ten feet below the water table interval at each deep monitoring well location will be analyzed for:

- Total Cyanide via USEPA Method 9012; and
- Fluoride via USEPA method 300.

In addition to the sampling listed above, 20% of the soil samples collected from the surface interval (0 – 0.5 ft-bls) will be laboratory analyzed for lead in both sieved (250 microns/No. 60 sieve) and bulk form. The samples selected for both analyses will account for different sources, lithology, or other characteristics that could influence the ratio between sieved and unsieved sample concentrations. Once the two sets of data are available, a ratio of sieved analysis to bulk analysis can be calculated for each sample, and then a 95% upper confidence limit (UCL) on the mean of all the ratios can be calculated. The UCL of the ratios may then be used as a factor that can be applied to historic, current, and future bulk samples to estimate lead concentrations.

The soil samples collected within the Rectifier Yards will be analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) via USEPA Method 8290. As described in Sections 2.8.5 and 2.8.8., historical fires and PCB remedial actions have been documented within the Rectifier Yards. PCDDs and PCDFs are by-products that occur when PCB fluid is partially burned.

A summary of the proposed soil samples are further described in the SAP and the sampling methods are further described in the QAPP. Selected soil boring locations will be completed as monitoring wells to be included as part of the Site-wide groundwater investigation activities. At deep monitoring well locations where potential confining units are encountered during the drilling of pilot borings (as evidenced lithology observed in the continuous core samples), ~~where shallow contamination is evident based on field observations during the soil investigation,~~ double-cased sonic~~well~~ drilling ~~and/or other sonic drilling~~ procedures will be used to hydraulically isolate monitoring wells screened with the deeper glacial aquifer(s) from the overlying groundwater system; thereby minimizing any potential for cross contamination. A description of the double casing methods is further described in the SAP. Groundwater investigation activities are further described in Section 5.6.

5.3.3 Storm Drain / Dry Well Sampling

Dry wells and drainage structures associated with the former plant operations are shown on Plate 3. As described in the CSM, drainage structures and dry wells represent a potential pathway for COPCs to migrate towards groundwater and surface water receptors. In coordination with the planned demolition activities, all accessible drains and basins will be inspected visually for potential impacts (staining, odors, PID readings, etc.), and where feasible, a sediment sample will be collected from each feature and screened via PID. Sediment will also be sent for laboratory analyses and analyzed for the same constituents as described in the soil sampling program above.

A soil boring will be drilled at the location of Drywell 31, which based on historical Site drawings was potentially used as a discharge location for chemical wastes generated in the Lab Building. In addition, during Phase I a soil boring will be completed to evaluate subsurface soils beneath at least three additional dry well locations. The locations will be selected following evaluation of sediment screening and laboratory data. The screening and sampling activities will be conducted at the beginning of the Phase I investigation activities to allow time for evaluation of data and selection of the boring locations to be drilled and sampled during Phase 1.

5.3.4 Waste Material Characterization

There is potential for waste materials related to former operations to be encountered at the surface in some portions of the Site. For example, areas of surficial tar / pitch are present around the Paste Plant. Where observed, the visual characteristics of waste will be described in the field notebook, the area and estimated amount will be noted, and the waste will be photo-documented.

Representative samples of any observed waste will be collected and analyzed to determine the COPCs present and whether the waste exhibits hazardous waste characteristics based on RCRA Regulatory Limits. In addition to the analyses noted for source area soil borings, which will also be performed on waste samples, waste characterization samples will also be analyzed for the following parameters:

- TCLP VOCs;
- TCLP SVOCs;
- TCLP metals;
- TCLP pesticides; and
- General waste parameters including ignitability, corrosivity, and reactivity.

5.4 Operation Area Soil Investigation

A soil sampling program will be conducted in areas of the Site not currently identified as potential source areas in the preliminary CSM, but where historical operations may have been conducted based on review of aerial photographs and understanding of Site operations. As part of the Operational Area soil investigation, surface and shallow subsurface soil samples will be collected to assess soil quality conditions, generate data for use in risk assessment, and to screen for the presence of any additional potential source areas that have not been previously identified in the CSM (if any).

The surface soil investigation will be implemented using an incremental soil sampling method in general accordance with the USEPA guidance for sampling design (USEPA, 2002) and the

Interstate Technology & Regulatory Council (ITRC) Incremental Sampling Methodology (ITRC, 2012). The incremental sampling methodology (ISM) provides representative samples of specific soil volumes defined as decision units (DUs) by collecting numerous increments of soil (typically 30 or more increments) that are combined, processed, and subsampled according to specific protocols. Evaluation of study results has shown that ISM for soil provides a better estimate of the average (mean) concentration within "decision units" (i.e., individual grid cells of specified size), and within the overall area of investigation, than can be obtained from a conventional discrete sampling approach. Decision units that exhibit COPCs at concentrations exceeding ARARs or risk-based criteria may require a more focused investigation during subsequent phases of the RI.

The Operational Soil Area will have two different types of decision units. A DU size of approximately one acre was selected for establishing the sampling grid where historical operations may have been conducted. The sampling will be conducted at the frequency of one incremental surface soil sample (0 to 6-inches bls) and one incremental shallow soil sample (0.5 to 2 ft-bls) per one acre DU. The entire Operation Soil Area can also be treated as a single DU, with 43 individual sampling units from which incremental soil samples will be collected. This approach is beneficial because there is no specific source area that has been defined within the Operational Soil Area. This approach will allow for calculation of the mean soil concentration and 95% upper confidence limit (UCL) of the mean for all analytes across the area based upon 43 ISM sample locations. These data can be used in comparison to background concentrations, as well as to compare maximum concentrations detected in entire dataset to conservative screening criteria. The Operational Soil Area sampling grid is shown in Figure 17.

In addition to the surface and shallow sampling activities, soil borings may be completed within the operational area soil investigation areas to permit sampling of deeper soil horizons. Soil borings will be completed utilizing sonic-rotary methods and/or direct push techniques. At all of the soil boring locations, continuous core samples will be collected from land surface to the bottom of the borehole in an effort to obtain lithologic and soil screening data. All of the soil samples will be described in accordance with the USCS. The core samples will be examined for evidence of potential impacts (i.e., staining, odor) and screened for the potential presence of

VOCs using a PID. The final depth of each soil boring will vary depending on observations during drilling and the location of the boring.

Soil samples collected within the Operational Area will be analyzed for the same analyses described in Section 5.3.2. Selected soil boring locations may be completed as monitoring wells to be included as part of the Site-wide groundwater investigation activities pending field observations. Groundwater investigation activities are further described in Section 5.6.2.

5.5 Background Area Soil Investigation

A soil sampling program will be conducted in background areas of the Site not currently identified as potential source areas in the preliminary CSM. The Background Area was generally defined in the western portion of the Site where aerial photographs show unforested areas throughout the entire history of the Site and no indication of industrial activity. As part of the Background Area soil investigation, soil samples will be collected to assess background soil quality conditions and~~,~~ generate data for use in risk assessment~~, and to screen for the presence of any additional potential source areas that have not been previously identified in the CSM (if any)~~.

Eight soil borings are proposed within the Background Area as shown on Figure 18~~7~~. Soil sampling from the borings within the Background Area will be conducted at the same frequency of the source area borings including one surface soil sample (0 to 6-inches bls), one shallow soil sample (0.5 to 2 ft-bls), and one deeper sample from 10-12 ft-bls. Soil samples collected within the Background Area will be analyzed for the same analyses described in Section 5.3.2.

If data collected from the background locations suggest additional source areas of COPCs are present, additional background locations will be selected and sampled in consultation with the USEPA.

5.6 Site-Wide Groundwater and Surface Water Investigation

This section describes the Site-wide investigation of groundwater flow, groundwater quality, and surface water quality.

5.6.1 Monitoring Well Installation

During the soil boring investigation, selected soil borings will be completed as monitoring wells. The new monitoring wells will be used to supplement the existing monitoring well network at the Site. The proposed locations were selected to provide detailed characterization around potential source areas and broad coverage across the Site (including in downgradient areas from Site features and in proximity to potential receptors). Deep monitoring wells will also be screened in different horizons of the groundwater flow system to evaluate the vertical extent of groundwater impacts and the flow through various hydrogeologic units. The proposed locations of the new monitoring wells are described in the SAP.

Monitoring wells will be constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and 2-inch diameter, 20-slot (0.020 inches) PVC screen flush-threaded onto the PVC casing. Surface completion of each well will consist of a protective stick-up enclosure and a locking J-plug. Newly constructed monitoring wells will be developed and allowed a minimum of one-week to equilibrate with the surrounding formation.

5.6.2 Groundwater Gauging and Sampling

Water levels will be measured in all new and existing monitoring wells on a quarterly basis for a period of one year following installation of all Phase 1 wells to evaluate groundwater elevations and flow directions. Selected wells will also be gauged before and after at least two storm precipitation events to assess short term variability in groundwater elevations. At least six monitoring wells will be fitted with pressure transducers to document the seasonal fluctuations of ground water levels. Groundwater elevation data developed during the gauging events will be used to evaluate groundwater flow beneath the Site, assess for temporal variations in groundwater flow and update the CSM as needed.

Groundwater samples will be collected from all newly-constructed monitoring wells and existing monitoring wells and production wells on a quarterly basis for a period of one year following installation of all Phase 1 wells to characterize groundwater quality beneath the Site and evaluate seasonal variations in groundwater quality. The existing wells where samples will be collected will depend on the results of the Site reconnaissance and the condition of the existing wells. Additionally, the feasibility of sampling the production wells and whether such sampling will produce representative groundwater data will be evaluated during the Site reconnaissance. The proposed groundwater sample locations are further described in the project specific SAP.

Groundwater samples will be collected using the methods described in *Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling* (USEPA, 2010). During purging, a water quality meter will be used to monitor water quality indicator parameters such as pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), temperature, and turbidity. The field parameters will be recorded on monitoring well sampling datasheets and submitted with the final RI summary report.

All groundwater samples will be analyzed for the following parameters:

- Dissolved TAL metals via USEPA Methods 200.7 / 200.8/ 245.2 / 6010C / 6020A / 7470A;
- Total cyanide via USEPA Method 335.4;
- General chemistry including Fluoride via USEPA method 300, alkalinity via method SM2023B, and hardness via USEPA method 200.7;
- Nutrients including Chloride and Sulfate via USEPA method 300.0, Nitrate and Nitrite as N via USEPA method 353.2, ammonia nitrogen via USEPA method 350.1/350.3, and orthophosphate as P via USEPA method 365.1; and
- Total dissolved solids (TDS) and total suspended solids (TSS) via methods SM 2540C/D.

The initial groundwater samples collected adjacent to potential source areas will also be analyzed for the following additional parameters:

- TCL VOCs via USEPA Method 8260; and
- TCL SVOCs via USEPA Method 8270.

All groundwater samples submitted for analysis of dissolved metals will be field filtered using a standard 0.45 micron filter.

It is anticipated that select samples will also be analyzed for free cyanide via ASTM D2036 and/or available cyanide via USEPA Method OIA-1677. However, the specific methods will be finalized in consultation with the selected analytical laboratory and identified in the Phase 1 SAP addendum prior to the initiation of sampling.

PCBs or pesticides in groundwater samples will not be analyzed for unless deemed warranted based upon their detection in source area soil samples or other locations. Similarly, unless warranted based upon the detection of VOCs or SVOCs in source area groundwater samples, the downgradient groundwater samples will not be analyzed for these parameters.

5.6.3 Surface Water Sampling

Surface water samples will be collected from surface water bodies present at the Site to evaluate surface water quality. Samples will be collected from within Site features, if water is present in the feature, including:

- North-East Percolation Pond
- North-West Percolation Pond
- South Percolation Ponds
- Seep
- Cedar Creek
- Cedar Creek Reservoir Overflow Drainage
- Flathead River

Multiple samples will be collected within the Flathead River to assess surface water quality at various locations within the river, including at locations downgradient of the Site. The proposed surface water sample locations are further described in the SAP.

All surface water samples will be analyzed for the following parameters:

- Total recoverable TAL metals via USEPA Methods 200.2 / 200.7 / 200.8/ 245.2 / 6010C / 6020A / 7470A;
- Total cyanide via USEPA Method 335.4; and
- General chemistry including Fluoride via USEPA method 300, alkalinity via method SM2023B, and hardness via USEPA method 200.7;

- Nutrients including Chloride and Sulfate via USEPA method 300.0, Nitrate and Nitrite as N via USEPA method 353.2, ammonia nitrogen via USEPA method 350.1/350.3, and orthophosphate as P via USEPA method 365.1; and
- Total dissolved solids (TDS) and total suspended solids (TSS) via methods SM 2540C/D.

The initial surface water samples collected within the percolation ponds will also be analyzed for the following additional parameters:

- TCL VOCs via USEPA Method 8260;
- TCL SVOCs via USEPA Method 8270;
- TCL PCBs via USEPA Method SW8082; and
- TCL Pesticides via USEPA Method 8081.

It is anticipated that select samples will also be analyzed for free cyanide via ASTM D2036 and/or available cyanide via USEPA Method OIA-1677. However, the specific methods will be finalized in consultation with the selected analytical laboratory and identified in the Phase 1 SAP addendum prior to the initiation of sampling.

Surface water samples will be collected on a quarterly basis for one year to evaluate seasonal variations in water quality and will coincide with the collection of groundwater samples. During each sampling event, discharge of Cedar Creek and Cedar Creek Drainage Overflow will be measured when flowing. Additionally, a temporary staff gauge will be installed within the Flathead River to enable measurement of river level conditions immediately adjacent to the Site. For the Flathead River, the instantaneous discharge measurement from USGS Station 12363000, located down river of the Site, will be recorded. The temporary staff gauge will be surveyed and correlated to the USGS station 12363000. River levels measured at the staff gauge will be used in conjunction with measured groundwater elevations to evaluate groundwater / surface water interactions.

As part of sample collection activities within the surface water bodies, the surface water samples will be field analyzed with a water quality meter to evaluate water quality parameters including temperature, conductivity, pH, dissolved oxygen, and oxygen reduction potential (ORP). The water quality meter will be placed directly in the surface water body and will be monitored until stable readings are observed. The readings will be recorded on a field datasheet and the location within the surface water body will be noted.

5.6.4 Sediment Sampling

Sediment samples will be collected from the same locations as surface water samples. Sediment samples will be analyzed with the same methods as soils described in Section 5.4, including grain size analysis and total organic carbon. Gravel and larger sized grains will be removed from the sample prior to packaging and shipment for laboratory analysis.

Seasonal conditions will be taken into account when collecting sediment samples. It is anticipated the sediment sampling activities will be performed in spring conditions when river stage is at a low level and such that the Flathead River is most likely acting as a gaining stream. The proposed sediment sample locations are further described in the SAP.

5.7 Fate and Transport Evaluation

The evaluation of contaminant fate and transport at the Site will be performed in an iterative fashion during the course of the Remedial Investigation. The evaluation will begin -d~~D~~uring the Phase I Site Characterization with the collection and evaluation of analytical data and hydrogeologic data, and will be continued subsequent to collecting additional hydrogeologic data during ~~into~~ the Phase II investigation.~~;~~ ~~analytical data will be collected to facilitate evaluation of contaminant fate and transport processes.~~ Field data recommended for chemical fate and transport modeling are described in Table 3 of the MDEQ guidance document titled "Technical Guidance General Field Data Needs for Fate and Transport Modeling" (MDEQ, 2008). As discussed in Section 5.3.2, soil properties data to be collected in Phase I relevant to fate and transport evaluation will include total organic carbon, grain size, bulk density and moisture content analysis. As described in Sections 5.6.2 and 5.6.3, groundwater and surface water data relevant to fate and transport evaluation include field parameters such as pH, dissolved oxygen, temperature, and ORP, and analytical parameters listed in the nutrient and metal parameter list.

At the completion of the Phase 1 Site Characterization the available information regarding the Site hydrogeology, geochemical characteristics, source area characteristics, and COPCs (concentrations and areal and vertical extent) will be used to update the CSM. Numerous maps and cross sections will be prepared to illustrate the hydrogeology, groundwater flow directions and gradients (both horizontal and vertical), general site geochemistry, and the distribution of COPCs in the environmental media at the Site. The water level data from monitoring wells and surface water gauging locations will be used to evaluate the interaction between groundwater and surface water at the Site; which will have direct bearing on the movement of COPCs between these media, as well as sediment and sediment pore water.

Because the preliminarily identified COPCs at the Site include fluoride and cyanide, consideration will be given to geochemical reactions that may impact both the mobility and toxicity of these species. For example, the concentration of fluoride in solution may be influenced by precipitation and dissolution reactions in the aquifer, depending on groundwater pH and the concentrations of calcium and phosphate. Moreover, fluoride may form complexes with a variety of other ions, further impacting its mobility. Similarly, cyanide also readily forms aqueous complexes, particularly with metal ions such as iron, copper, and zinc. This complexation can impact toxicity (e.g., determining the extent to which total cyanide represents free CN- ion) and mobility, including the extent to which cyanide ion may adsorb onto anion exchangers such as iron, aluminum, and manganese oxyhydroxide mineral phases present in the aquifer.

Developing a detailed understanding of Site conditions as described above is a pre-requisite for determining the methods and scope of subsequent fate and transport evaluations.

It is recognized that in some cases it may be important to understand the rate and extent of transport processes utilizing mathematical models. Mathematical models are often used to predict these processes and estimate the changes in concentrations that are likely to occur. A groundwater flow and transport modeling approach may be applicable to quantify potential changes in ranges of anticipated chemical concentrations in groundwater and surface water under existing conditions and in response to possible remedial alternatives. The process fidelity of such modeling will strongly depend upon data quality and quantity; available options range from simplified analytical models to multidimensional numerical flow and transport models (e.g., MODFLOW and MT3DMS; Harbaugh, 2005, and Zheng and Wang, 1999, respectively). In addition, geochemical models such as PHREEQC (Parkhurst and Appelo, 1999) and accompanying thermodynamic databases can be used to directly address site-specific complexation and mobility-related processes that may occur with respect to both fluoride and cyanide.

The approaches that will be utilized to complete subsequent contaminant fate and transport evaluations, including an assessment of the potential applicability of modeling, will be provided in conjunction with the BRAWP based upon analysis of the Phase 1 Site Characterization results as described above. This will also include scoping and identification of any additional data required to support these evaluations.

5.8 Health and Safety Plan

A Site-specific Health and Safety plan (HASP) will be developed in accordance with guidelines outlined in OSHA standard 29 CFR 1910.120(b) and submitted under separate cover. The purpose of the HASP is to address the safety and health hazards that may exist during field operations and to identify procedures to ensure field operations are conducted as safe as possible with full consideration and awareness of the potential risks. The HASP will include a discussion of potential hazards, including biological hazards, precautions to be taken, equipment, clothing, training of personnel, Health and Safety Officer duties, notices and signs, and activities to inform and protect the public. A copy of the HASP will be available at the Site at all times during implementation of the RI/FS.

6.0 BASELINE RISK ASSESSMENT

A baseline human health risk assessment (BHHRA) and an ecological risk assessment (ERA) will be conducted to evaluate the potential threat posed by environmental conditions at the Site in the absence of any remedial action. The BHHRA and ERA will provide the basis for determining whether remedial action is necessary in the various areas of the Site as well as the extent of remedial action required. A Baseline Risk Assessment Work Plan (BRAWP) will be prepared at the conclusion of the Phase 1 Site Characterization to provide a detailed description of the methodology and assumptions to be utilized in completing the BHHRA and ERA. A Baseline Risk Assessment Report (BRAR) that documents entire risk assessment process and presents the results of the BHHRA and ERA will be prepared following the completion of the final phase of the Site characterization (i.e., either Phase 2 Site Characterization or after any subsequent phases of Site characterization, if necessary). The overall approach and a general description of the scope of work to complete the BHHRA and ERA are provided below.

6.1 BHHRA Approach

The primary regulatory guidance for conducting human health risk assessments is presented in a series of USEPA publications: Risk Assessment Guidance for Superfund, Volume I: Parts A through F (USEPA 1989, 1991a, 1991b; 2001a, 2001b, 2004, and 2009b); commonly referred to as RAGS Part A thru Part F. The USEPA has issued additional risk assessment guidance beyond that which is presented in RAGS. The purpose of this additional guidance is to provide risk assessment guidance that, when used in conjunction with RAGS, reflects current scientific knowledge.

The following is a partial list of additional guidance documents (referenced in the risk assessment guidance on the MDEQ website) that will be utilized in conjunction with RAGS for completion of the BHHRA:

- Human Health Toxicity Values in Superfund Risk Assessments (Environmental Protection Agency, Washington, DC. - OSWER 9825.7-53, December 2003)
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (Environmental Protection Agency, Washington, D.C. - OSWER 9825.6-10, December 2002)

- Exposure Factors Handbook: 2011 Edition - Environmental Protection Agency, Washington, DC, (USEPA, 2011)
- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (OSWER Directive 9200.1-120, February 2014)

The baseline risk assessment will be conducted in a phased approach. As described in Section 3.3, the RI scoping process included development of a preliminary CSM depicted in Figure 10 to facilitate identification of the data required to support a BHHRA. The CSM identifies potentially complete exposure pathways based upon current land use at and in vicinity of the Site. The CSM will be re-evaluated and updated during preparation of the BRAWP based upon the results of the Phase 1 Site Characterization Program. The updated CSM will identify exposure pathways as incomplete, complete, or potentially complete, and present the associated rationale; considering both current and potential future land use.

6.1.1 Exposure Pathways

The Phase 1 Site Characterization program has been designed considering the preliminary CSM to ensure that data needed for risk assessment purposes are collected to enable further evaluation of each potentially complete exposure pathway. A brief discussion of these pathways and the pertinent data to be collected during the Phase 1 Site Characterization program (described in detail in Section 5.0) is provided below.

6.1.1.1 Groundwater Pathway

Potentially complete groundwater exposure pathways have been identified for offsite residents, Site workers and Site visitors / trespassers. Offsite residents rely upon groundwater for their source of potable water. Therefore, ingestion of COPCs in water, inhalation of COPCs volatilized during washing or showing, and dermal contact with COPCs while washing/bathing are potential exposure routes. With respect to Site workers, groundwater is not currently used as source of potable water at the Site. However, dermal contact with and inhalation of COPCs are identified as potential exposure routes for Site workers in event of any subsurface excavations that may encounter contaminated groundwater.

The Phase 1 Site Characterization program will determine the types and concentrations of COPCs in groundwater across the Site via the installation and sampling of groundwater monitoring wells. The wells are to be installed in upgradient areas of the Site, near and downgradient of known and potential source areas, and near the Site boundary that is adjacent to offsite residents. Groundwater samples will be collected over four consecutive quarters to characterize the seasonal variation in COPC concentrations. The groundwater data from wells closest to the offsite residential area, as well as from the ongoing quarterly monitoring of residential wells, will be used to evaluate whether the exposure pathways for offsite residents are complete or incomplete based upon the current groundwater quality.

The Phase 1 and Phase 2 Site Characterization programs will also develop the hydrogeologic and geochemical data to enable evaluation of the fate and transport COPCs in groundwater which is required to assess how groundwater quality may change over time beneath the Site and in the vicinity of potential receptors. A summary of the data to be collected, the overall approach to the RI and the Phase 1 Site Characterization Program is provided Section 4.1, 4.2 and Section 5.0, respectively.

6.1.1.2 Surface Water and Sediment Pathway

Dermal contact with surface water and sediment is identified in the CSM as a potentially complete exposure pathway for offsite residents, Site workers and Site visitors / trespassers. The Phase 1 Site Characterization program includes sampling and analysis to determine the types and concentrations of COPCs in surface water and sediment within the Flathead River, Cedar Creek, and Cedar Creek Overflow Drainage, as well as within the percolation ponds. Surface water sampling will be conducted over four consecutive quarters to assess seasonable variability in water quality. The results of the hydrogeologic investigations will used to evaluate groundwater/ surface water interactions in order to develop a better understanding of where groundwater containing COPCs may potentially discharge to surface water. The need and potential locations for additional surface water and sediment sampling, including sediment pore sampling, will be determined based upon evaluation of the Phase 1 sampling results.

6.1.1.3 Food Chain Pathway

The food chain pathway has been identified as potentially complete because the Flathead River is used by Site visitors for recreational fishing within the Site study area. In addition, land owned by CFAC has been used by Site visitors and potentially by site trespassers for recreational hunting. Therefore, the food chain pathway will require further evaluation. As described in Section 6.2, the Phase 1 Site Characterization program includes a Screening Level Ecological Risk Assessment (SLERA) to determine whether potential risk to ecological receptors occurs at the Site under current and future conditions and to identify which Contaminant(s) of Potential Ecological Concern (COPECs). The food chain pathway is one of the exposure pathways to be evaluated during the SLERA. The findings of the SLERA and Phase 1 Site Characterization program will provide data needed to determine if the human food chain requires further evaluation in the BHHRA. These data include the types, concentrations, and distributions of COPCs across the Site, and a conservative assessment of the potential for the types of COPCs identified to bio-accumulate within the food web.

6.1.1.4 Soil Vapor Pathway

The CSM identifies soil vapor as a potentially complete exposure pathway for Site workers and terrestrial biota via inhalation route of exposure. VOCs have only been detected at low concentrations in groundwater at the Site (maximum concentration of 6.2 µg/L) and only at two monitoring well sampling locations. As result, there currently appears to be low potential for soil vapor concern at the Site. However, because widespread sampling for VOCs in soil and groundwater has not been conducted to date, the soil vapor has been retained for further evaluation. The Phase 1 Site Characterization includes analysis of all subsurface soil samples and all groundwater samples for VOCs. In addition, a passive soil vapor survey will be conducted in areas that were identified as potential sources of VOCs. The findings from these activities will used to determine if the soil vapor pathway requires further evaluation in the BHHRA.

6.1.1.5 Soil Pathway

The CSM identifies surface soil and subsurface soil as potentially complete exposure pathways for Site workers, visitors / trespassers, and biota via the direct contact, ingestion and inhalation routes of exposure. The Phase 1 Site Characterization Program includes collection of soil samples at and around potential source areas and across the entire operational area of the Site. Surface soil samples will be collected for laboratory analysis at each location from land surface to a depth of six inches. The data from these intervals will be utilized to evaluate the ingestion, inhalation, and dermal contact exposure routes for site visitors / trespassers as well as for site workers performing routine, non-intrusive work activities. Subsurface soil samples will be collected from 0.5 to 2 ft and from deeper depths. The analytical results for subsurface soil samples will be utilized to evaluate potential exposures to Site workers who perform intrusive work activities such as excavation. The analytical results for soil samples will also be used to evaluate potential for COPCs in soil to serve as a continuing source to groundwater.

6.1.2 Preliminary Exposure Areas and Approach for Identification of COPCs

Given the size and varying land use characteristics across the Site, multiple exposure areas will be defined to enable risk characterization within different areas of the Site based upon the COPCs identified and their concentrations, land use characteristics and potential receptors within those areas. The actual exposure areas to be evaluated in the BHHRA and the exposure pathways associated with each area will be described in the BRAWP. A preliminary identification of potential exposure areas is provided below, which in general corresponds to the various RI Areas listed and described in detail Section 3.2.

- Main Plant Area
- Landfill Area(s)
- Northern Percolation Ponds
- Operational Soil Area
- Flathead River landside area, including Southern Percolation Ponds and the seep area
- Flathead River surface water and sediment
- Cedar Creek and Cedar Creek overflow drainage
- Aluminum City residential area (This area is not described in Section 3.2, because it is not within the Site). However, as described in Section 3.3.2.1, groundwater is used as the primary source of drinking water for this residential community located immediately west of the Site; therefore this area will be evaluated within the BHHRA).

The identification of COPCs for the BHHRA will primarily be based upon the dataset to be generated during RI during the Phase 1 Site Characterization Program. However, the EPA Site Reassessment completed in 2013 (described in Section 2.8.14), the ongoing residential well quarterly monitoring program described in Section 2.8.15, and the ongoing monitoring associated with the MPDES permit will also be utilized in this process.

The COPCs will be identified based upon comparison of analytical results from the above referenced investigations to human health screening levels drawn the following sources as indicated for each media type. Concentrations of naturally occurring substances will also be compared to concentrations measured at background and upgradient sampling locations to evaluate whether the measured concentrations of those substances are related to the Site. Human health risk-based screening levels (RSLs) provided in the EPA Risk-Based Screening Tables will be based on target cancer risk of 1E-06 and target hazard quotient of 0.1. For the purposes of identifying COPCs, the lowest value, across all sources, should be selected as the screening level:

Soil

- EPA Risk-Based Screening Tables: residential soil RSL, Risk-based soil screening level (SSL) for the protection of groundwater

- Montana Tier 1 Risk-based Corrective Action Guidance for Petroleum Releases (September 2009) for petroleum compounds

Surface Water and Groundwater

- EPA Risk-Based Screening Tables: tapwater RSL, drinking water maximum contaminant level (MCL)

- Montana DEQ Circular DEQ-7: http://www.deq.mt.gov/wqinfo/circulars.mcpx

Sediment

- EPA Risk-Based Screening Tables: residential soil RSL

6.1.3 BHHRA Sections of the BRAWP

The results of the Phase 1 Site Characterization will form the basis for preparation of the BRAWP. The BHHRA sections of the BRAWP are briefly described below.

- Data Evaluation and Selection of COPCs: This section of the BRAWP will present the results of data evaluation and selection of COPCs, by media and by exposure area, based upon the Phase 1 Site Characterization Program. An overview of the screening process is provided above. The data handling and processing methods utilized during the data evaluation and selection of COPCs will be fully documented in the BRAWP. EPA ProUCL will be utilized for statistical analyses required as part of the data evaluation process.

- Exposure Assessment: This section will provide the updated CSM to identify potential receptors and exposure pathways by exposure area. The exposure assessment will also identify types of exposure assumptions required to be utilized in calculations and the sources of information that will utilized to assign values based upon central tendency and reasonable maximum exposure. The exposure assessment will also develop and present the methodology to be used for calculations of exposure point concentrations and daily intakes.

- Toxicity Assessment: This section will present the sources of information and technical approach that will be used to develop and document the pertinent health-based information for each selected COPC. This will include the information pertinent to defining carcinogenic and non-carcinogenic risks, carcinogenic slope factors and inhalation unit risks, non-carcinogenic reference doses and reference concentrations and uncertainties associated with toxicity assessment.

- A risk characterization section will present how cancer risk estimates and non-carcinogenic hazard estimates will be derived. This section will also explain the uncertainties that are expected to be associated with the BHHRA.

The BRAWP will include completion of RAGS Table 1 to present the rationale for inclusion, or exclusion, of each exposure pathway; and, a preliminary version of RAGS Table 2 to summarize the results of the data evaluation and selection of COPCs (recognizing that Table 2 will require updating to incorporate the results from the Phase 2 Site Characterization Program). The BRAWP will also include example versions of RAGS Tables 3 thru 7 to illustrate the format expected to be followed for presentation of this information in the BRAR.

The evaluation of existing data and the preparation of the BRAWP will include scoping of any additional data required to complete BHHRA. These data requirements will be identified and incorporated into the Phase 2 Site Characterization SAP to be prepared following completion of the BRAWP.

6.2 ERA Approach

The primary regulatory guidance for the ERA at the Site is the "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments" (USEPA, 1997) (ERA Guidance). As specified in the ERA Guidance, the functions of the ecological risk assessment are to:

- Document whether actual or potential ecological risks exist at a site;
- Identify which contaminants present at a site pose an ecological risk; and
- Generate data to be used in evaluating cleanup options.

The ERA Guidance outlines a process that consists of eight steps and scientific management decision points (SMDPs) outlined below.

1. Screening-Level Problem Formulation and Ecological Effects Evaluation ....
2. Screening-Level Preliminary Exposure Estimate and Risk Calculation .... SMDP (a)
3. Baseline Risk Assessment Problem Formulation .... SMDP (b)
4. Study Design and Data Quality Objectives .... SMDP (c)
5. Field Verification of Sampling Design .... SMDP (d)
6. Site Investigation and Analysis of Exposure and Effects .... [SMDP]
7. Risk Characterization ....
8. Risk Management .... SMDP (e)

The corresponding SMDPs are:

(a) Decision about whether a full ecological risk assessment is necessary.

(b) Agreement among the risk assessors, risk manager, and other involved parties on the conceptual model, including assessment endpoints, exposure pathways, and questions or risk hypotheses.

(c) Agreement among the risk assessors and risk manager on the measurement endpoints, study design, and data interpretation and analysis.

(d) Signing approval of the work plan and sampling and analysis plan for the ecological risk assessment.

(e) Signing the Record of Decision.

[SMDP] only if change to the sampling and analysis plan is necessary.

The first two steps are commonly referred to as a Screening Level Ecological Risk Assessment (SLERA). SMDP (a) at the completion of Step 2 represents the point at which it is decided whether or not a full ecological risk assessment consisting of Steps 3 through 8, outlined above, is necessary. Therefore, a SLERA will be completed at the Site in conjunction with the Phase I Site Characterization program. The SLERA scope of work is provided in Appendix B and summarized below.

The specific goal of the SLERA is to provide a conservative evaluation of the likelihood for adverse effects (and the ecological significance of predicted adverse effects) to wildlife that may be exposed to Site-related constituents, so it can be decided whether a full baseline ecological risk assessment (BERA) is necessary. In addition, if a full BERA is determined to be necessary, the SLERA will provide the information necessary to develop a BERA work plan.

<u>Step 1 of the SLERA</u> is “Problem Formulation and Ecological Effects Characterization”; and consists of the following components:

- Characterization of environmental setting;
- Identification of constituents detected in relevant media;
- Description of constituent fate and transport pathways;
- Description of constituent mechanisms of ecotoxicity;
- Description of potentially affected receptors;
- Identification of potentially complete exposure pathways and CSM; and
- Identification of generic assessment and measurement endpoints.

<u>Step 2 of the SLERA</u> is “Screening Level Exposure Estimate and Risk Calculation”. During this phase of analysis, exposure to stressors and the relationship between stressor concentrations and ecological effects are evaluated. Maximum concentrations in environmental media (surface water, groundwater, sediment, soil) are the exposure estimates that will be compared to

corresponding media-specific conservative effects benchmarks in the SLERA. Ecological screening levels will be gathered from the following sources, as indicated for each media type:

Soil

- EPA Ecological Soil Screening Levels: http://www.epa.gov/ecotox/ecossl/
- Los Alamos National Laboratory (LANL) ECORISK Database, Los Alamos, New Mexico. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php
- Sample, BE, DM Opresko, GW Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision.* Oak Ridge National Laboratory. Document ES/ER/TM-86/R3. June 1996. http://www.esd.ornl.gov/programs/ecorisk/documents/tm86r3.pdf
- *Region 5 RCRA Ecological Screening Levels*, August 22. http://www.epa.gov/Region5/waste/cars/esl.htm

Surface Water and Groundwater

- EPA National Recommended Water Quality Criteria: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
- Suter II, GW and CL Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. Oak Ridge National Laboratory. Document ES/ER/TM-96/R2. June 1996. http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf
- Canadian Council of Ministers of the Environment (CCME). *Canadian Water Quality Guidelines, Summary Table,* http://st-ts.ccme.ca/
- Montana Department of Environmental Quality (DEQ) Circular DEQ-7: http://www.deq.mt.gov/wqinfo/circulars.mcpx

Sediment

- MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environmental Contamination and Toxicology* 39:20-31.
- Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella azteca* and the midge *Chironomus riparius; and*
- *Region 5 RCRA Ecological Screening Levels*, August 22. http://www.epa.gov/Region5/waste/cars/esl.htm

- USEPA Region 3 Biological Technical Assistance Group Freshwater Sediment Screening Benchmarks (August 2006)

In the case where a benchmark is unavailable for a detected compound or where a compound is determined to have sufficient potential to be persistent and bioaccumulative, it may be necessary to generate estimates of exposure and or effects for receptors of interest as described in the SLERA Scope of Work (Appendix B).

Since a SLERA is deliberately designed to be protective in nature, not predictive of effects, it follows that there is a considerable amount of uncertainty associated with results from a SLERA. Thus, to ascertain the confidence to be placed upon the SLERA, the potential sources of uncertainty will be evaluated within the context of the Site.

The activities performed during the SLERA and the associated results will be documented in a SLERA Summary Report.

6.3 Baseline Risk Assessment Work Plan and Baseline Risk Assessment Report

The Baseline Risk Assessment Work Plan (BRAWP) will be prepared following the completion of the Phase 1 Site Characterization and SLERA. This document will be prepared to be consistent with the approach outlined in the prior sections and with the requirements of the previously referenced guidance documents for BHHRA and, if warranted based upon the SLERA outcome, also for a baseline ecological risk assessment (BERA). The Baseline Risk Assessment Report will be prepared according to the methodology specified in the BRAWP after completion of the Phase 2 Site Characterization (or any additional phases of site characterization, if necessary).

7.0 FEASIBILITY STUDY

The Feasibility Study will be conducted in a phased approach that integrates with the phased approach to the RI and is in accordance with USEPA guidance and the requirements of the National Contingency Plan (NCP). As summarized in Section 3.4, a preliminary identification of potential remedial alternatives was conducted as part of the RI/FS scoping process. The identified alternatives provide a broad range of possible response actions that are potentially applicable to the various Site features and impacted media. The purpose of identifying remedial alternatives early in the RI/FS process was to facilitate scoping of data requirements for the Site characterization program.

7.1 Identification and Screening of Technologies

The next phase of the FS will be initiated at the end of the Phase 1 Site Characterization program. The Phase 1 Site Characterization data will be evaluated to identify and screen remedial technologies. The screening process will utilize the Federal Remediation Technology Roundtable (FRTR) Technology Screening Matrix as well as applicable USEPA guidance to identify candidate technologies for assembly into remedial alternatives. The results of the technology screening process will be summarized in a Candidate Technologies and Remedial Alternatives Memorandum. The listing of candidate technologies will cover the range of technologies required for alternatives analysis and will be presented in the context of potential remedial alternatives that address the various RI Areas and Site features. Additional data needs to support the subsequent development and evaluation of alternatives will also be identified in the memorandum, so that data to fulfill those needs can be collected during the Phase 2 Site Characterization or subsequent phases.

7.2 Feasibility Study Work Plan

A FS Work Plan will be prepared following completion of the Final RI Summary Report (including the BHHRA and SLERA). The FS Work Plan will build upon the results of the screening task (Section 7.1) and include the following information:

1. Preliminary iIdentification of remedial action objectives (RAOs), developed in consultation with USEPA, specifying contaminants and media of concern, potential exposure pathways. The identification of RAOs will consider both chemical-specific ARARs, the results of the risk assessment, and the potential future use(s) of the property.

2. Identification of the areas and volume of contaminated media exceeding the identified RAOs.

3. An identification and description of any interim actions that have occurred at the Site.

4. An alternatives screening table containing the alternatives remaining after the initial screening conducted as described in Section 7.1 above, which includes:

   a. Identification of the remaining potential remedy alternatives.

   b. Further evaluation of the retained alternatives based on effectiveness, implementability, and cost. The rationale for eliminating any remedial alternatives from further detailed evaluation will be documented as a footnote to the table or in a comment column.

   c. Remedial alternatives retained for detailed evaluation in the FS report.

   d. Identification of all retained potential remedial alternatives that may require treatability studies, including determination if treatability study is needed to support remedy selection or remedial design. If treatability studies are necessary for remedy selection, a treatability study work plan will be prepared.

7.3 Feasibility Study Report

A FS Report will be prepared to document the entire FS process, in accordance with the NCP, 40 CFR Part 300, as well as consistent with the most recent USEPA guidance.

The detailed evaluation of alternatives shall apply the first seven of the nine evaluation criteria described in the NCP, to the assembled remedial alternatives. The nine evaluation criteria include: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state (or support agency) acceptance; and (9) community acceptance.

The FS report shall contain the following sections:

- Summarize Feasibility Study objectives
- Summarize remedial action objectives
- Articulate general response actions
- Identification and screening of remedial technologies

- Remedial alternatives description
- Detailed analysis of remedial alternatives
- Summary and conclusions

The FS Report will be submitted to USEPA and/or MDEQ, as appropriate, for review and commentary.

8.0 DATA MANAGEMENT

The RI/FS will generate an extensive amount of information that needs to be properly documented and managed in order to support risk assessment, remedy selection decisions and any legal or cost recovery actions. Therefore, data management procedures will be followed to ensure the quality, validity and security of the RI/FS data. The following sections provide an overview of the procedures and requirements for field recordkeeping and the project database. Additional details and standard operating procedures are provided in the SAP.

8.1 Field Recordkeeping

Field logbooks and field datasheets will provide the means of recording the data collection activities. All field logbooks and datasheets will be scanned on weekly basis to create PDF files for electronic archiving with the central project file. A Standard Operating Procedure (SOP) for field recordkeeping is provided in the SAP. Some of the specific requirements with respect logbooks and field data are highlighted below.

8.1.1 Field Logbooks

Field logbooks will be used to document field activities and observations. The field notes will be clear, with sufficient detail so that events can be reconstructed later if necessary. Field logbooks will document any field deviations from the RI/FS Work Plan and/or SAP, as well as the reasons for the changes. Requirements for logbook entries include the following:

- Separate field activity logbooks will be kept for each task.
- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, is prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made will be noted as well as the time of the observation itself).
- Each consecutive day's first entry will be begun on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 a.m. for 9 a.m. and 2100 for 9 p.m.), will be recorded on each page.

- When field activity is complete, the logbook will be entered into the permanent project file.

In addition to the preceding requirements, the person recording the information will initial and date each page of the field logbook. If more than one individual makes entries on the same page, each recorder will initial and date each entry. Logbook corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written next to the original entry. Corrections will be initialed and dated. Separate logbooks for each activity may be needed because several field activities may occur at once.

8.1.2 Field Datasheets

Field datasheets will be utilized when appropriate to achieve efficient and standardized recording of field measurements and observations. The type of field data sheet and the information recorded on it may vary by activity. At a minimum, field datasheets will be completed for each sample to document the unique sample identifier assigned, provide information on whether the sample is representative of a field sample or a field-based quality control sample (e.g., field blank, field duplicate), provide information regarding the sample media, sample date, sample location, sample GPS coordinates, and sampling team members for every sample. All datasheets must be entered into electronic format. Datasheets may also be used to document information such as habitat descriptions, sediment sample characteristics (e.g., color, texture, etc.), water level gauging data, surface water and groundwater sample field observations and measurements (e.g., pH, temperature, color, clarity, etc.). A reference date and activity will be entered into the logbook to refer to the field data sheets being generated. The field data sheets will be put into electronic format and become a permanent record within the project file. When the field data sheet entries are entered in an electronic format, each sheet will be annotated to indicate who completed the data entry and when.

8.1.3 Sample Nomenclature, Chain of Custody and Tracking Procedures

All field measurement locations, sampling locations, and samples, including samples collected for QA/QC purposes, will be assigned a unique Site-specific identification number. The identification number will be used to track field-screening data and laboratory analytical results in the project database, as well as for presentation of the data in memoranda and reports. During the investigation, the sample identification numbers will be recorded in the field logbook, on field datasheets, on the sample jars, and on the Chain of Custody (COC) paperwork.

The Site-specific sample nomenclature format and COC procedures are described in the SAP.

8.2 Project Database

A database will be created to organize, analyze, and store project information and data. EQuIS™, a relational database system based on Microsoft Access, is the system currently planned for use at the Site. EQuIS™ or an alternative system will similar capabilities will be used to:

- Provide a single centralized repository for field measurement data and laboratory analytical results (e.g., soil, groundwater, surface water, sediment).
- Provide a user-friendly interface for database queries and generation of data summary tables.
- Allow the data to be viewed and displayed in a GIS compatible format, along with other GIS data layers.
- Provide detailed information about sampling locations, sample types, sampling and analytical methods, results, and QA information.
- Provide simple comparisons to regulatory standards or risk-based screening levels, along with calculations of descriptive statistics.
- Generate export files to spreadsheets, data analysis software, or other databases according to their requirements.

Laboratory analytical data will be added to the database using standardized formats and a QA program. The QA program checks the format and completeness of chemical data. Most data will be transferred directly from the laboratories via electronic files to eliminate the potential for error during keyboard data entry.

All data that is manual input into the database will be printed, 100% verified against the original source documents, and corrected if necessary within the EQuIS system. The hard copies will be initialed as they are checked during verification of electronic versions of the original source documents.

9.0 RI/FS REPORTING

The following sections summarize the ~~main~~ deliverables that will serve to document the results of the RI/FS at the Site. Additional submittals may be added to those described below based upon the scoping process that will continue throughout the RI/FS process. A summary of the submittals, including a schedule for each submittal, is provided in Table 3.

All of the RI/FS deliverables listed below and in Table 3, as well as any additional deliverables required during the course of the project, will be initially submitted to USEPA and MDEQ as draft documents. Following receipt of USEPA comments, the documents will be revised as appropriate and submitted in final form for approval by USEPA.

9.1 Phase I Site Characterization SAP Addendum

As described in Section 5.2.5, adjustments to SAP may be required based upon the results of the pre-intrusive investigation activities described above. These adjustments may include modification or elimination of sampling locations or analyses, as well as the addition of sampling locations. A SAP Addendum will be prepared to document any adjustments and their associated rationale prior to mobilization for additional Phase I Site Characterization activities.

9.2 Phase I Site Characterization Data Summary Report

The results of Phase I of the RI will be compiled and presented in a Phase I RI Data Summary Report. This report will include tables, maps, any deviations/corrective actions from the RI Work Plan, and analyses required to identify and scope subsequent phases of field work. ~~Data gaps identified following the review of the Phase I data, if any, will be identified and discussed in the Phase I RI Data Summary Report.~~

9.3 SLERA Summary Report

The findings of SLERA described in Section 6.2 and Appendix B will be presented in a summary report.

9.4 Baseline Risk Assessment Work Plan

The BRAWP will be prepared following the completion of the Phase 1 Site Characterization and SLERA. The anticipated contents of the BRAWP are described in Section 6.0. Data gaps relevant to the risk assessment that are identified following the review of the Phase I data, if any, will be identified and discussed in the ~~Phase I RI Data Summary Report~~Baseline Risk Assessment Work Plan.

9.5 Candidate Technologies and Remedial Alternatives Memorandum

The results of the technology screening process will be summarized in a Candidate Technologies and Remedial Alternatives Memorandum. The anticipated contents of the memorandum are described in Section 7.1.

9.6 Phase II Site Characterization Sampling and Analysis Plan

The Scope of Work for Phase II of the investigation activities will be developed to address data gaps, if any, determined based on the results of the Phase I Site Characterization or identified during preparation of the BRAWP. The Phase II Site Characterization will be focused on collecting any additional data required to complete the risk assessment and comprehensive feasibility study. The Phase II SAP will identify the additional sampling locations and methods that will be implemented as part of Phase II activities.

9.7 Phase II Site Characterization Data Summary Report

The results of Phase II of the RI will be compiled and presented in a Phase II Data Summary Report. This report will include tables, maps, and any deviations/corrective actions from the Phase II SAP.

9.~~7~~ 8 Baseline Risk Assessment Report

The Baseline Risk Assessment will be summarized in a report following the completion of all phases of the RI and the BHHRA and ERA. The anticipated contents of the Baseline Risk Assessment Report are described in Section 6.0.

9.~~8~~ 9 Final RI Summary Report

After completion of all of the phases of the RI, a comprehensive RI Report will be prepared to present and evaluate the data for meeting the stated RI objectives. The RI report will include the following:

- Site description;

- Physical characteristics of the study area;
- Summary of RI Scope of Work;
- Nature and extent of contamination;
- Data validation and usability;
- Contaminant fate and transport evaluation; and
- Results of the BHHRA and ERA.

The RI Report will be prepared in accordance with USEPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (October 1988). Field data (e.g., geologic logs, field data sheets, field notes, etc.), laboratory data, validation reports, and any other pertinent data will be included as appendices in the Final RI Summary Report.

9.~~9~~ 10 Feasibility Study Work Plan

A FS Work Plan will be prepared following completion of the Final RI Summary Report and the Baseline Risk Assessment Summary Report. The anticipated contents of the FS Work Plan are provided in Section 7.2.

9.~~10~~ 11 Feasibility Study Report

A FS Report will be prepared to document the entire FS process, in accordance with the NCP, 40 CFR Part 300, as well as consistent with the most recent USEPA guidance. The FS report will include a detailed evaluation of alternatives as described in Section 7.3.

10.0 PROJECT MANAGEMENT PLAN

The following section describes the management plan for the RI/FS activities, including a proposed schedule for conducting Phase I of the RI activities.

10.1 Project Personnel

The overall RI/FS support will be provided by Roux Associates. A number of individuals will be involved in the RI/FS and in the collection and management of data. Certain individuals will have specifically designated responsibilities that will be consistent throughout the duration of the RI/FS. The personnel with specifically designated responsibilities include:

- RI/FS Project Manager
- RI Manager
- FS Manager
- Project Health and Safety Officer
- QA Officer
- Data Validator
- Environmental Geologists/Engineers/Technicians
- Risk Assessment Managers

The RI/FS Project Manager has the responsibility to oversee the overall implementation and completion of the RI/FS Scope of Work. The Project Manager will manage the technical and administrative aspects of the project and will function as Roux Associates' primary contact with CFAC, USEPA, and MDEQ.

The RI Manager will be the contact responsible for overseeing the implementation of the RI. The RI Manager will ensure that data collection is carried out according to the RI Work Plan. The RI Manager will also oversee any subcontractors for any task where subcontractors may be required (e.g., drilling, geophysical survey, etc.). The RI Manager will be responsible for communicating updates on the status of the RI tasks to the Project Manager.

The FS Manager is responsible for developing the Scope of Work and overseeing the various parts of the FS. The FS Manager will communicate with the RI/FS Project Manager and RI Manager during the design of the RI to collect data that can be used to support the FS.

Health and safety will be a shared responsibility of all project personnel that visit the Site during the RI activities. The overall health and safety management during field activities will be stewarded by a Project Health and Safety Officer. The Project Health and Safety Officer will be responsible for ensuring that all project personnel, including subcontractors, adhere to the requirements in the Health and Safety Plan (HASP).

A QA Officer will be assigned to oversee QA/QC responsibilities on the project. The QA Officer will be responsible for conducting sampling QA/QC audits to ensure that data being collected during the RI meets the data quality objectives outlined in the Work Plan. The QA Officer will ensure that data is being collected in accordance with the SOPs provided in the QAPP. The QA Officer will also be responsible for communicating with the analytical laboratory about potential QA/QC issues, if any.

Roux Associates will coordinate data validation through a third-party Data Validator. The Data Validator will be responsible for validating analytical data received from the laboratory to ensure it meets the data quality objectives outlined in the QAPP and USEPA data validation guidelines. The Data Validator will provide a summary of the data validation results for inclusion in the summary reports.

Environmental geologists, engineers, and technicians will be responsible for conducting the field activities associated with the RI/FS activities. These personnel will perform Site reconnaissance, oversee subcontractors, and conduct sampling activities. The geologists, engineers, and technicians will be managed by the RI Manager.

The risk assessment managers are responsible for developing the Scope of Work and overseeing the human health and ecological risk assessments. They will communicate with the Project Manager during the design of the RI to collect data that can be used to support the risk assessments.

Communication will be maintained among project personnel described above in accordance with the project organizational chart (Figure 18). Additional project personnel may be added to the project on an as needed basis.

10.2 Coordination with USEPA

Coordination with the USEPA will be important to successful implementation of the RI/FS. CFAC will provide the USEPA with oral notification, or written notification via email, at least 30 days prior to the start of any field investigation activities described in Sections 5.2 through 5.6 of this RI/FS Work Plan. At EPA's oral or written request, or the request of the EPA's oversight assistant, CFAC will allow split or duplicate samples to be taken by EPA (and its authorized representatives) and/or DEQ of any samples collected. Following completion of field activities, CFAC will also provide notification of completion within 30 days for each phase of the Remedial Investigation.

Throughout the RI/FS, CFAC will participate in meetings with the EPA to discuss the technical aspects of the RI/FS. Additionally, CFAC will provide to EPA and DEQ quarterly progress reports for the periods, November/December/January, by February 30th, and February/March/April, by May 30th. CFAC will also provide the EPA and the DEQ monthly progress reports during the months of May through October by the 30th day of the following month. The quarterly progress reports will discuss work completed and data collected during the reporting period, work planned for the next reporting period, and any deviations and/or modifications from the RI/FS Work Plan.

10.3 Project Schedule

A preliminary schedule for implementation of the RI/FS activities has been developed based on the proposed Scope of Work in this Work Plan and the preliminary CSM. The major phases of work outlined in this Work Plan along with a preliminary schedule of completion dates are listed below:

- ~~RI/FS Work Plan Finalization (4th Quarter 2015);~~
- Phase I Site Characterization Field Program (4th Quarter 2016);
- Phase I Data Summary Report ~~and Phase II SAP~~ (1st Quarter 2017);

- Baseline Risk Assessment Work Plan (~~2nd~~ 4th Quarter 2017);
- Phase II Site Characterization Field Program (3rd 4th Quarter ~~2017~~2018);
- Phase II Data Summary Report (1st Quarter 2019)
- Baseline Risk Assessment (3rd Quarter 2019)
- ~~and~~ Final RI Report (~~3rd~~ 1st Quarter 2020~~18~~);
- FS Work Plan (~~1st~~ 3rd Quarter ~~2019~~2020); and
- Feasibility Study (~~4th~~ 1st Quarter 2021~~19~~).

A detailed project schedule outlining the anticipated timing and duration of each Phase 1 Site Characterization field task will be provided once the Work Plan and associated documents are finalized and key subcontractors have been selected.

A summary of the RI/FS deliverables, including a schedule for each deliverable, is provided in Table 3. Highlighted within Table 3 are six major deliverables with specific scheduled due dates as summarized below:

- Draft Baseline Risk Assessment Report (3/1/2019)
- Final Baseline Risk Assessment Report (7/29/2019)
- Draft Remedial Investigation Report (9/27/2019)
- Final Remedial Investigation Report (2/24/2020)
- Draft Feasibility Study Report (10/12/2020)
- Final Feasibility Study Report (3/12/2021)

The above schedule dates and dates provided in Table 3 may require modification during the course of the RI/FS based upon, among other factors, the regulatory review and approval process, the availability of specialized subcontractors for certain aspects the work, adjustments or additions to the scope of work ~~for various phases of work~~ based upon field conditions or the findings of earlier phases of work. The need for certain types of studies, as well as the scale and scope of work for such studies, will be dependent upon the information developed during the RI/FS. These potential studies include a full baseline ecological risk assessment, development of numerical models for simulation of contaminant fate and transport; and treatability studies. Since the need and scope of such studies is uncertain at this time, these studies have not been included within the overall schedule.

Management of the schedule will be an important focus throughout the duration of all RI/FS activities. ~~The schedule will be periodically reviewed and updated as the work progresses.~~ Many of the tasks in the RI/FS are independent; however, where possible, tasks will be conducted concurrently to facilitate progress. The schedule will be periodically reviewed and updated as the work progresses. If a schedule extension is required to meet the due dates listed in Table 3 for any of the deliverables, a formal notification and request for a schedule extension will be submitted to USEPA. If a schedule extension is required for any major deliverable, the notification and request for a schedule extension will be submitted no less than 30 days prior to the deliverable due date. Any notification and request for a schedule extension will present the rationale for why an extension is needed, discuss measures that have been and/or will be taken to minimize the schedule extension, and present the new deliverable due date.

~~Following the review and approval process for this Work Plan and the associated supporting documents, Site characterization activities will begin.~~

Respectfully submitted,

ROUX ASSOCIATES, INC.

Kelly Coulon
Project Engineer

Michael Ritorto
Senior Hydrogeologist

Andrew Baris
Principal Hydrogeologist/
Vice President

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